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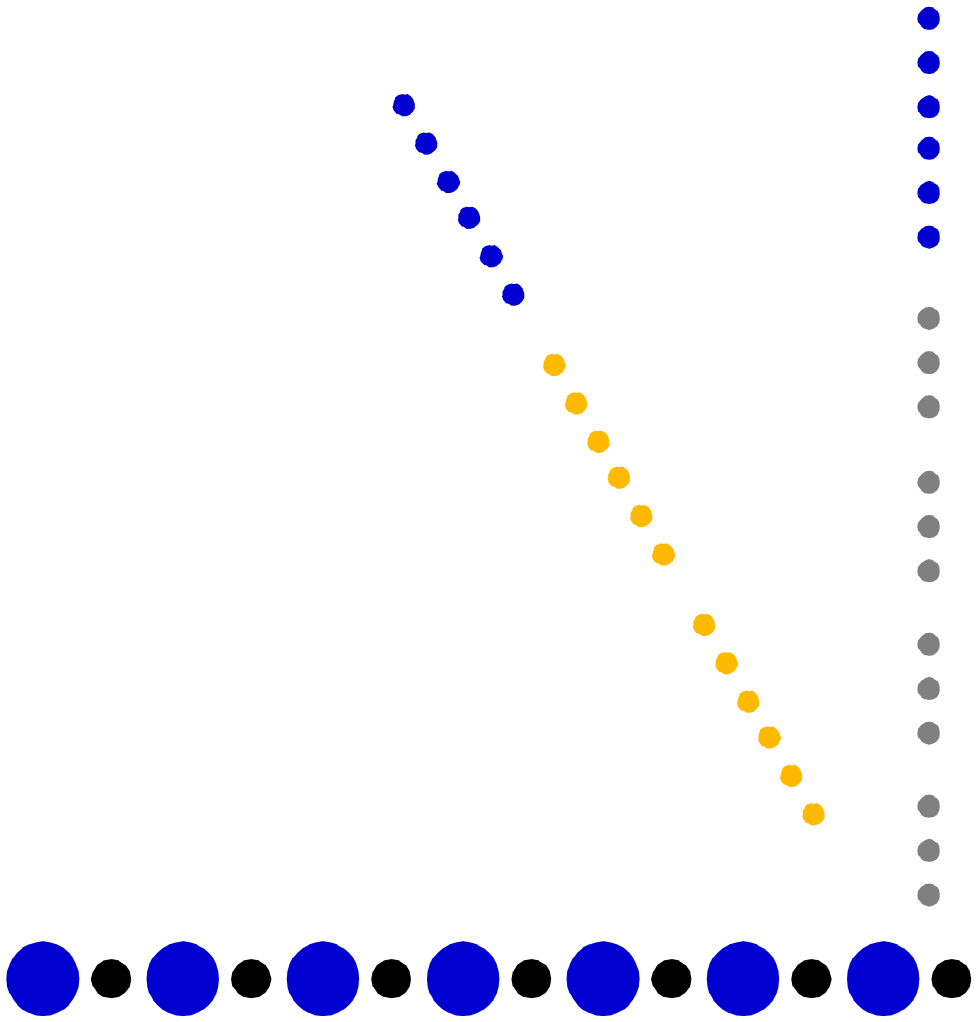
SDLT 220 and SDLT 320 SCSI Interface Guide



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Revision History

All revisions made to this document are listed below in chronological order.

Document Release	Date	Summary of Changes
A01	May 30, 2002	Initial release.
A02	September 30, 2002	Features corresponding to v55 are now described. Also, a few small errors in the previous version were corrected.

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CHAPTER 1

Introduction

1.1 Purpose and Scope

This reference guide is a comprehensive source of information about SCSI commands and SCSI messages used by the Super DLTtape-generation tape drives. This document is written for original equipment manufacturers (OEMs) that are integrating the Quantum Super DLTtape drive into a system or subsystem. Background knowledge about the SCSI standard is assumed.

This document's primary audience is the OEM technical system integrators who are responsible for the SCSI interface. Additionally, the manual can be used by technically astute end-users for installation and operation of the tape drive, although that group is a secondary audience.

1.2 Referenced Documents

- *Super DLTtape™ Interactive Library Interface Specification* 66-80000-00

1.3 Related Documents

- *SDLT 220 and SDLT 320 Design and Integration Guide* 86-80002-01
- *SDLT 220 and SDLT 320 Product Manual* 81-85002-01
- *SDLT 1.5 (320) Engineering Specification* 82-80005-00
- *DLT Script Tool User Guide* 86-60010-01.

1.4 Structure of this Manual

- **Chapter 1, Introduction**, is the chapter you are currently reading.
- **Chapter 2, SCSI Parallel Interface**, provides a small amount of SDLT-specific SCSI information. (Background knowledge about the SCSI-2 standard is assumed.)
- **Chapter 3, SCSI Messages**, provides a list and description of SCSI messages supported by the tape system. The SCSI message system allows communication between SCSI initiators and SCSI targets (the tape drive, in this case) for interface management and for command elaboration and qualification.
- **Chapter 4, SCSI Commands**, describes in detail each command supported by the tape system. The SCSI command system enables a SCSI initiator to direct a tape system to perform a wide range of operational and diagnostic functions. This chapter also provides sense key and additional sense code information for the REQUEST SENSE and SEND DIAGNOSTIC SCSI commands as well as density codes for the MODE SELECT and MODE SENSE commands.

1.5 Conventions

This manual uses the following conventions to designate specific elements:

Table 1-1. Typographical Conventions

Element	Convention	Example
Commands	Uppercase (unless case-sensitive)	TEST UNIT READY
Messages	Uppercase	IDENTIFY
Hexadecimal Notation	Number followed by lowercase h	25h
Binary Notation	Number followed by lowercase b	101b
Decimal Notation	Number without suffix	512
Acronyms	Uppercase	POST
Abbreviations	Lowercase, except where standard usage requires uppercase	Mb (megabits) MB (megabytes)

1.6 For More Information

The web site ***http://www.superdlttape.com*** includes much valuable information about SDLT systems; or to locate very specific product-related information, visit ***http://www.quantum.com/SDLT***.

For personalized information about Quantum's reliable data protection products, call 1-800-624-5545 in the U.S.A. and Canada.

1.7 Reader Comments

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CHAPTER 2

SCSI Parallel Interface

This chapter covers the following topics:

- "Background Information About SCSI" describes previous knowledge you need to have before you can successfully use this manual.
- "Information Transfer Phases" describes the specifics of information transfer in SDLT drives.
- "SCSI Bus Conditions" describes the two asynchronous conditions of the SCSI bus.

2.1 Background Information About SCSI

Small Computer System Interface (SCSI) is one of the industry's most widely adopted I/O interfaces; it is widely used from personal computers to mainframes to peripheral devices of all types. Super DLTtape drives conform to the SCSI-2 standard (with extensions from SCSI-3). We request that you familiarize yourself with the SCSI-2 standard prior to using the remaining portions of this manual.

Important features of SCSI-2 implementation include the following:

- Efficient peer-to-peer I/O bus with up to 15 devices
- Asynchronous transfer rates that depend only on device implementation and cable length
- Logical addressing for all data blocks (rather than physical addressing)
- Multiple initiators and multiple targets
- Distributed arbitration (bus contention logic)
- Command set enhancement.

NOTE: Complete sets of SCSI standards are available at ***www.t10.org***.

2.2 Information Transfer Phases

The COMMAND, DATA, STATUS, and MESSAGE phases are known as the *information transfer phases* because they are used to transfer data or control information. Keep the following guidelines in mind:

- The SDLT tape drive supports wide asynchronous and synchronous data transfers.
- Odd parity is generated during all information transfer phases during which the device writes data to the SCSI bus, and parity is checked during all transfer phases in which data is read from the bus by the tape drive.
- Super DLTtape drives support block sizes from 4 bytes to 16,777,212 bytes.
- The tape drive disconnects from the SCSI bus at regular intervals during information transfer phases to allow other devices to access the bus. These disconnects are user-configurable via the Disconnect-Reconnect Page of the MODE SELECT command.
- The tape drive does not act as an initiator on the SCSI bus. Therefore, the drive does not: 1) generate unsolicited interrupts to the bus, 2) initiate its own SCSI commands, and 3) assert bus reset.
- HVD and combination LVD/Single-ended versions of the tape drive are available.

2.3 SCSI Bus Conditions

The SCSI bus has two asynchronous conditions:

- Attention Condition
- Reset Condition

2.3.1 Attention Condition

The attention condition informs a drive that an initiator has a message ready. The drive gets the message by performing a MESSAGE OUT phase. The attention condition requires the following timing:

- The initiator creates the attention condition by asserting ATN at any time except during the ARBITRATION or BUS FREE phases.
- The initiator negates the ATN signal at least two deskew delays before asserting the ACK signal while transferring the last byte of the message.
- If an initiator wishes to send a message before transitioning to a new bus phase, the initiator asserts the ATN signal, then waits at least two deskew delays before negating the ACK signal for the last byte transferred in the current bus phase. Asserting the ATN signal later may not be honored until a later bus phase which may result in an unexpected action.

The drive responds with MESSAGE OUT, as described in the following table:

Table 2-1. Drive's MESSAGE OUT Phase Response

ATN Signal True in Phase...	The Drive Enters MESSAGE OUT…
COMMAND	After transferring part or all of the command descriptor block bytes.
DATA	At the drive's earliest convenience (often on a logical block boundary). The initiator continues REQ/ACK handshakes until it detects the phase change.
STATUS	After the status byte has been acknowledged by the initiator.
MESSAGE IN	Before it sends another message. This permits a MESSAGE PARITY ERROR message from the initiator to be associated with the appropriate message.
SELECTION*	Immediately after that SELECTION phase.
RESELECTION‡	After the drive has sent its IDENTIFY message for that RESELECTION phase.

* Before the initiator releases BSY, provided the initiator asserted ATN.

‡ The initiator should only assert the ATN signal during a RESELECTION phase to transmit a BUS DEVICE RESET or DISCONNECT message.

The initiator keeps the ATN signal asserted if more than one byte is to be transferred. The initiator may negate the ATN signal at any time, except it should not negate ATN while the ACK signal is asserted during a MESSAGE OUT phase.

NOTE: Normally, the initiator negates the ATN signal while the REQ signal is true and the ACK signal is false during the last REQ/ACK handshake of the MESSAGE OUT phase.

2.3.2 Reset Condition

The tape drive responds to bus reset conditions as follows:

- Within 250 milliseconds (typically under 4 milliseconds) after a bus reset, the tape drive responds to SCSI bus selections and returns the appropriate normal responses. Tape motion commands are returned with Check Condition status, Sense Key of Not Ready, until the medium has been made ready.
- The tape medium is rewound to Beginning of Partition (BOP, which is Beginning of Tape [BOT]).

NOTE: The tape drive does not implement the hard reset alternative for bus RESET processing.

The tape drive recognizes multiple bus resets in succession as well as bus resets of arbitrarily long duration (power on conditions). It recovers within the time limits specified above following the last bus reset.

CHAPTER 3

SCSI Messages

This chapter contains a detailed description of the SCSI messages supported by Super DLTtape drives. Specifically, it covers the following topics:

- "Evolution of SCSI Messages" compares SCSI-2 messages with SCSI-3 messages.
- "Message Format" lists the specific format of SCSI messages.
- "Supported SCSI Messages" contains descriptions of each of the messages supported by the drive.

3.1 Evolution of SCSI Messages

The SCSI message system allows communication between an initiator and the drive for interface management and command qualification. Messages can be originated by either the initiator or the drive.

In the SCSI-3 standard, the names of many of the messages changed from the names used in SCSI-2 without significant changes to their meanings. This manual uses the SCSI-2 message names throughout. For your convenience, Table 3-1 provides a translation between the SCSI-2 names and the SCSI-3 names for the supported messages:

Table 3-1. SCSI-2 and SCSI-3 Message Names (a Comparison)

SCSI-2 Name	SCSI-3 Name
ABORT	ABORT TASK SET
ABORT TAG	ABORT TASK
BUS DEVICE RESET	TARGET RESET
CLEAR QUEUE	CLEAR TASK SET
COMMAND COMPLETE	TASK COMPLETE
DISCONNECT	DISCONNECT
IDENTIFY	IDENTIFY
IGNORE WIDE RESIDUAL	IGNORE WIDE RESIDUAL
INITIATOR DETECTED ERROR	INITIATOR DETECTED ERROR
LINKED COMMAND COMPLETE	LINKED COMMAND COMPLETE
LINKED COMMAND COMPLETE (WITH FLAG)	Obsolete
MESSAGE PARITY ERROR	MESSAGE PARITY ERROR
MESSAGE REJECT	MESSAGE REJECT
NO OPERATION	NO OPERATION
RESTORE POINTERS	RESTORE POINTERS
SAVE DATA POINTER	SAVE DATA POINTER
SYNCHRONOUS DATA	SYNCHRONOUS DATA
TRANSFER REQUEST	TRANSFER REQUEST
TERMINATE I/O PROCESS	Obsolete
WIDE DATA TRANSFER REQUEST	WIDE DATA TRANSFER REQUEST

3.2 Message Format

A message can be one or more bytes in length. One or more messages can be sent during a single MESSAGE phase, but a message cannot be split over MESSAGE phases. The initiator is required to end the MESSAGE OUT phase (by negating ATN) when it sends certain messages that are identified in Table 3-4.

When a connection to the drive is established (that is, the drive is selected with ATN asserted), the first message byte passed by the initiator must be either an IDENTIFY, ABORT, or BUS DEVICE RESET message. If not, the drive discards the message, saves no status information, and goes to the BUS FREE phase.

If an initiator supplies an unsupported message (for example, COMMAND COMPLETE or a reserved or undefined message code), the drive returns a MESSAGE REJECT message and continues where it left off (possibly returning to MESSAGE OUT if ATN is raised).

The first byte of the message, as defined in Table 3-2, determines the format of the message.

Table 3-2. SCSI Message Format

Message Code	Message
00h	One-byte message (COMMAND COMPLETE)
01h	Extended message
02h – 1Fh	One-byte message
20h – 2Fh	Two-byte message
40h – 7Fh	Reserved
80h – FFh	One-byte message (IDENTIFY)

Two-byte messages consist of two consecutive bytes. The value of the first byte, as defined in Table 3-2, determines which message is to be transmitted. The second byte is a parameter byte that is used as defined in the message description.

A value of 1 in the first byte indicates the beginning of a multiple-byte extended message. The minimum number of bytes sent for an extended message is three. The extended message format is shown in Figure 3-1, and the data fields are described in Table 3-3.

Bit / Byte	7	6	5	4	3	2	1	0
0	Extended Message (01h)							
1	Extended Message Length							
2	Extended Message Code							
3 to n-1	Extended Message Arguments							

Figure 3-1. Extended Message — Data Format

Table 3-3. SDLT 220/320 Extended Message — Field Descriptions

Field	Description
Extended Message Length	This field specifies the length, in bytes, of the Extended Message Code plus the Extended Message Arguments that follow. Therefore, the total length of the message is equal to the Extended Message Length plus 2. A value of 0 for the Extended Message Length indicates that 256 bytes follow.
Extended Message Code	The drive supports the following Extended Messages. They are: **Code** **Description** 01h Synchronous Data Transfer Request 03h Wide Data Transfer Request

3.3 Supported SCSI Messages

This section contains descriptions of each of the messages supported by the drive.

The Super DLTtape drive supports the messages listed in Table 3-4. The message code and the direction of the message flow is also included in the table (In = target-to-initiator, Out = initiator-to-target).

Table 3-4. SDLT 220/320 Supported Messages

Message and Code	Direction	
ABORT (06h)		Out
BUS DEVICE RESET (0Ch)		Out
COMMAND COMPLETE (00h)	In	
DISCONNECT (04h)	In	Out
EXTENDED MESSAGE (Synchronous Data and Wide Data Transfer Requests) (01h) *	In	Out
IDENTIFY (80h - FFh)	In	Out
IGNORE WIDE RESIDUE (23h)	In	
INITIATOR DETECTED ERROR (05h)		Out
LINKED COMMAND COMPLETE (0Ah)	In	
LINKED COMMAND COMPLETE WITH FLAG (0Bh)	In	
MESSAGE PARITY ERROR (09h)		Out
MESSAGE REJECT (07h)	In	Out
NO OPERATION (08h)		Out
RESTORE POINTERS (03h)	In	
SAVE DATA POINTER (02h)	In	
SYNCHRONOUS DATA TRANSFER REQUEST (extended message 01h)	In	Out
WIDE DATA TRANSFER REQUEST (extended message 03h)	In	Out

* Extended message (see Figure 3-1 and Table 3-3).

3.3.1 ABORT (06h)

This message is sent from the initiator to the target to clear the current I/O process on the selected unit. Buffered (cached) write operations are completed if possible. The target goes directly to the BUS FREE phase after successful receipt of this message. Current settings of MODE SELECT parameters and reservations are not affected. Commands, data, and status for other initiators are not affected.

This message may be sent to a logical unit that is not currently performing an operation for the initiator. If no unit has been selected, the target goes to BUS FREE phase and no commands, data, or status on the target are affected.

If a WRITE command is in progress and STATUS has not been sent to the initiator when this message is received, some or all of the data for this command might be written to the medium.

3.3.2 BUS DEVICE RESET (0Ch)

The BUS DEVICE RESET message is sent from an initiator to direct the drive to clear all I/O processes on the drive. The message causes the drive to:

1. Flush the contents of cache to tape and go to the BUS FREE phase.

2. Execute a soft reset, leaving it as if a Bus Reset had occurred.

The drive creates a Unit Attention condition for all initiators after accepting and processing a Bus Device Reset message. The additional sense code is set to BUS DEVICE RESET OCCURRED.

If a WRITE command is in progress and STATUS has not been sent to the initiator when this message is received, some or all of the data for this command might be written to the medium.

3.3.3 COMMAND COMPLETE (00h)

The COMMAND COMPLETE message is sent by the drive to an initiator to indicate that an I/O process has completed and that valid status has been sent to the initiator. After successfully sending this message, the drive goes to the BUS FREE phase by releasing the BSY signal. The drive considers the message transmission successful when it detects the negation of ACK for the COMMAND COMPLETE message with the ATN signal false. If a COMMAND COMPLETE message is received by the tape drive, it is handled as an illegal message: the drive returns MESSAGE REJECT.

3.3.4 DISCONNECT (04h)

The DISCONNECT message is sent from the drive to inform the initiator that the present connection is going to be broken (the drive plans to disconnect by releasing the BSY signal) and a later reconnect will be required to complete the current I/O process. The message does not cause the initiator to save the data pointer. After sending the message, the drive goes to the BUS FREE phase by releasing the BSY signal.

The DISCONNECT message may also be sent by the initiator to tell the drive to suspend the current phase and disconnect from the bus. The drive's response to and its handling of a DISCONNECT message are based on when, in the I/O process, the initiator introduces the DISCONNECT message. Table 3-5 summarizes the drive's response.

Table 3-5. Drive's Response to DISCONNECT Message

BUS Phase	Drive Response
SELECTION	The drive discards the DISCONNECT message and goes to BUS FREE.
COMMAND	The drive discards the DISCONNECT message and goes to BUS FREE. The ATTENTION request is ignored while the Command Descriptor Block is fetched. The drive does not switch to MESSAGE OUT until the current DMA completes.
DATA	The ATTENTION request is ignored while the current data transfer completes; that is, the drive does not switch to MESSAGE OUT until after the current DMA completes. The drive returns a MESSAGE REJECT message and responds with CHECK CONDITION status, indicating the command aborted because of an invalid message.
STATUS	The drive sends a MESSAGE REJECT message, then sends COMMAND COMPLETE.
MESSAGE IN	The drive sends a MESSAGE REJECT message and switches to the BUS FREE phase.

3.3.5 IDENTIFY (80h - FFh)

The IDENTIFY message is sent by either the initiator or the drive to establish or re-establish the physical connection path between an initiator and target for a particular logical unit under the conditions listed below. Figure 3-2 shows the format of the IDENTIFY message and Table 3-6 describes the data field contents.

Bit	7	6	5	4	3	2	1	0
	Identify	DiscPriv	LUNTAR	Reserved		LUNTRN		

Figure 3-2. IDENTIFY Message — Data Format

Table 3-6. IDENTIFY Message — Field Description

Field	Description
Identify	The Identify bit must be set to 1. This identifies the message as an IDENTIFY message.
DiscPriv	Disconnect Privilege. The DiscPriv can be 0, provided that no other I/O process is currently active in the drive. If not set to 1 and other I/O processes are currently active in the drive, the drive returns BUSY status.
LUNTAR	The Logical Unit/Target Routine (LUNTAR) field must be set to zero. A LUNTAR bit of one causes the drive to send a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST, INVALID BITS IN IDENTIFY MESSAGE.
Reserved	The Reserved bits must be zero. If a reserved bit is non-zero, the drive sends a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST, INVALID BITS IN IDENTIFY MESSAGE.
LUNTRN	Logical Unit Number.

3.3.6 IGNORE WIDE RESIDUE (23h)

The IGNORE WIDE RESIDUE message is sent by the target to the initiator to indicate that the number of valid bytes sent during the last REQ/ACK handshake and REQB/ACKB handshake of a DATA IN phase is less than the negotiated transfer width. The Ignore field indicates the number of invalid data bytes transferred. This message is sent immediately following that DATA IN phase and prior to any other messages. Figure 3-3 illustrates the data format of an IGNORE WIDE RESIDUE message. Table 3-7 describes the Ignore field bit definitions.

Bit / Byte	7	6	5	4	3	2	1	0
0	Message Code (23h)							
1	Ignore (01h)							

Figure 3-3. IGNORE WIDE RESIDUE Message — Data Format

Table 3-7. IGNORE WIDE RESIDUE Message — Field Definitions

Ignore	Invalid Data Bits (16-bit Transfers)
00h	Reserved
01h	DB(15 - 8)
02h - FFh	Reserved

3.3.7 INITIATOR DETECTED ERROR (05h)

The INITIATOR DETECTED ERROR message is sent from an initiator to inform the drive that an error has occurred that does not preclude the drive from retrying the operation (a bus parity error, for example). The source of the error may either be related to previous activities on the SCSI bus or may be only drive-related. When received, the tape drive may attempt to re-transfer the last command, data, or status bytes by using the RESTORE POINTER message mechanism.

The drive's response to and its handling of an INITIATOR DETECTED ERROR message are based on when, in the I/O process, the initiator introduces the message. Table 3-8 summarizes the drive's response.

Table 3-8. Drive's Response to INITIATOR DETECTED ERROR Message

Bus Phase	Drive Response
SELECTION	The drive discards the INITIATOR DETECTED ERROR message and then goes to the BUS FREE phase.
COMMAND	The drive discards any Command Descriptor Block bytes fetched from the initiator, sets the Sense Key to ABORTED COMMAND, sets the Additional Sense Code to INITIATOR DETECTED ERROR MESSAGE RECEIVED. It sends the CHECK CONDITION status and the COMMAND COMPLETE message and then goes to the BUS FREE phase.
DATA	The drive discards the INITIATOR DETECTED ERROR message and sets the Sense Key to ABORTED COMMAND, sets the Additional Sense Code to INITIATOR DETECTED ERROR MESSAGE RECEIVED. It sends the CHECK CONDITION status and the COMMAND COMPLETE message and then goes to the BUS FREE phase.
STATUS	The drive sends a RESTORE POINTERS message, returns to the STATUS phase, resends the STATUS command, and continues the I/O process.
MESSAGE IN	The drive discards the INITIATOR DETECTED ERROR message and sets the Sense Key to ABORTED COMMAND, sets the Additional Sense Code to INITIATOR DETECTED ERROR MESSAGE RECEIVED. It sends the CHECK CONDITION status and the COMMAND COMPLETE message and then goes to the BUS FREE phase.

3.3.8 LINKED COMMAND COMPLETE (0Ah)

This message is sent from a target to an initiator to indicate that the execution of a linked command (with the FLAG bit set to zero) is complete and that status has been sent. The initiator then sets the pointers to the initial state for the next command.

If received by a target, this message is handled as an illegal message; the drive enters the MESSAGE IN phase and returns MESSAGE REJECT.

3.3.9 LINKED COMMAND COMPLETE WITH FLAG (0Bh)

This message is sent from a target to an initiator to indicate that the execution of a linked command (with the FLAG bit set to one) is complete and that status has been sent.

3.3.10 MESSAGE PARITY ERROR (09h)

This message is sent from the initiator to tell the drive that the last message byte the drive passed on to the initiator contained a parity error.

To indicate that it intends to send the message, the initiator sets the ATN signal before it releases ACK for the REQ/ACK handshake of the message that has the parity error. This provides an interlock so that the target can determine which message has the parity error. If the target receives this message under any other condition, it proceeds directly to the BUS FREE state by releasing the BSY signal, signifying a catastrophic error.

The target’s response to this message is to switch to the MESSAGE IN phase and re-send from the beginning all the bytes of the message that precipitated the MESSAGE PARITY ERROR message.

3.3.11 MESSAGE REJECT (07h)

This message is sent from the initiator or target to indicate that the last message received was inappropriate or has not been implemented.

To indicate its intention to send this message, the initiator asserts the ATN signal before it releases ACK for the REQ/ACK handshake of the message that is to be rejected. MESSAGE REJECT is issued in response to any message the drive considers to be illegal or not supported. When sending to the initiator, the tape drive does so before requesting any additional message bytes.

3.3.12 NO OPERATION (08h)

If a target requests a message, the initiator sends a NO OPERATION message if it does not currently have any other valid message to send. The NO OPERATION message is ignored by the tape drive.

3.3.13 RESTORE POINTERS (03h)

The RESTORE POINTERS message is sent from the drive to the initiator to direct the initiator to copy the most recently saved command, data, and status pointers for the I/O process to the corresponding current pointers. The command and status pointers are restored to the beginning of the present command and status areas. The data pointer is restored to the value at the beginning of the data area in the absence of a SAVE DATA POINTER message or to the value at the point at which the last SAVE DATA POINTER message occurred for that logical unit.

When the RESTORE POINTERS message is received as a target, the target switches to the message in phase and returns MESSAGE REJECT.

3.3.14 SAVE DATA POINTER (02h)

The SAVE DATA POINTER message is sent from the drive to direct the initiator to copy the current data pointer to the saved data pointer for the current I/O process.

The tape drive sends this message before a disconnect during a data transfer. It may not send a SAVE DATA POINTER message if it intends to move directly to STATUS phase. If the drive receives this message, it switches to message in phase and returns MESSAGE REJECT.

3.3.15 SYNCHRONOUS DATA TRANSFER REQUEST (extended message 01h)

This extended message allows the target and initiator to agree on the values of the parameters relevant to synchronous transfers. By default, the tape drive will not initiate the SYNCHRONOUS DATA TRANSFER REQUEST message; it relies on the initiator to do so. The SYNCHRONOUS DATA TRANSFER REQUEST message has the format shown in Figure 3-4.

NOTE: The tape drive supports initiating synchronous transfer negotiations with the host, but this feature is disabled by default. To enable it, set the MODE SELECT Vendor Specific EEPROM parameter EnaInitSyncNeg.

Bit / Byte	7	6	5	4	3	2	1	0
0	Extended Message Identifier (01h) (see Figure 3-1)							
1	Length (03h)							
2	SYNCHRONOUS DATA TRANSFER REQUEST (01h)							
3	Transfer Period							
4	Transfer REQ/ACK Offset							

Figure 3-4. SYNCHRONOUS DATA TRANSFER REQUEST Message — Data Format

A SYNCHRONOUS DATA TRANSFER REQUEST message exchange is initiated by a SCSI device whenever a previously arranged transfer agreement may have become invalid. The agreement becomes invalid after any condition that may leave the data transfer agreement in an indeterminate state, such as:

- After any SCSI reset condition,
- After a BUS DEVICE RESET message,
- After a power cycle,
- After a WIDE DATA TRANSFER REQUEST message exchange.

The SYNCHRONOUS DATA TRANSFER REQUEST message exchange establishes an agreement between two SCSI devices on the clocking of the data used for DATA phase transfer between them. This agreement applies to DATA IN and DATA OUT phases only. All other information transfer phases must use asynchronous transfers.

The tape drive implements both wide data transfer option and synchronous data transfer option. If both wide and synchronous data transfers are to be used, the wide data transfer agreement must be negotiated first. If a synchronous data transfer agreement is in effect, then after accepting a WIDE DATA TRANSFER REQUEST message, it resets the synchronous agreement to asynchronous mode.

If the Transfer Period requested is lower than the minimum value supported by the device, the return value will be adjusted up to the minimum supported value.

All possible transfer periods between the minimum and maximum values are not supported. If the Transfer Period requested is between the minimum and maximum supported values, but not exactly achievable by the device, the returned value will be the request value and the drive will transmit data at the next lower speed it is capable of. The initiator may send data at the request speed. The maximum supported synchronous period is 5Dh (372 nsec). A request with a Transfer Period lower than this will return a request for asynchronous mode.

Table 3-9. Transfer Periods and Transfer Rates

Transfer Period	Transfer Rate
0Ah	40 MHz, 25 nsec Transfer Period
0Bh	33 MHz, 30.3 nsec Transfer Period. Super DLTtape uses 37.5 nsec period.
0Ch	20 MHz, 50 nsec Transfer Period
0Dh – 5Dh	(4 * Transfer Period) nsec

The minimum supported value for Transfer Period is 0Ah when the bus is operating in LVD mode. When operating in HVD or SE (Single-Ended) mode, the minimum Transfer Period value is 0Ch.

The Transfer REQ/ACK offset may be any value between 0 and 62. A value of 0 indicates asynchronous transfers. A request with a value greater than 62 will cause the device to return a request for 62.

3.3.16 WIDE DATA TRANSFER REQUEST (extended message 03h)

Figure 3-5 illustrates the message formats.

Bit / Byte	7	6	5	4	3	2	1	0
0	Extended Message Identifier (01h) (see Figure 3-1)							
1	Extended Message Length (02h)							
2	WIDE DATA TRANSFER REQUEST (03h)							
3	Transfer Width Exponent							

Figure 3-5. WIDE DATA TRANSFER REQUEST Message — Data Format

A WIDE DATA TRANSFER REQUEST message exchange is initiated by a SCSI device whenever a previously arranged transfer width agreement may have become invalid. The agreement becomes invalid after any condition that may leave the data transfer agreement in an indeterminate state such as

- After a hard reset condition,
- After a BUS DEVICE RESET message,
- After a power cycle.

The WIDE DATA TRANSFER REQUEST message exchange establishes an agreement between two SCSI devices on the width of the data path to be used for DATA phase transfer between them. This agreement applies to DATA IN and DATA OUT phases only. All other information transfer phases must use an 8-bit data path.

The tape drive implements both wide data transfer option and synchronous data transfer option. If both wide and synchronous data transfers are to be used, the wide data transfer agreement must be negotiated first. If a synchronous data transfer agreement is in effect, then after accepting a WIDE DATA TRANSFER REQUEST message, it resets the synchronous agreement to asynchronous mode.

The transfer width that is established applies to all logical units. Valid transfer widths for the Super DLTtape drive are 8 bits (*transfer width* = 00h) and 16 bits (*transfer width* = 01h). Other transfer widths are reserved.

CHAPTER 4

SCSI Commands

This chapter describes the supported SCSI commands, options, and error recovery procedures implemented in the Quantum Super DLTtape drive system. However, this chapter *does not* fully reiterate every ANSI SCSI message, option, and command code specification; for information of this nature, refer to the SCSI specification itself.

The web sites ***http://www.scsita.org*** and ***http://www.t10.org*** are also helpful sources of information.

4.1 Overview of SCSI Command and Status Processing

The SDLT 220/320 SCSI feature set can be described as “SCSI-2 plus”; this means that the Super DLTtape drive supports:

- All of the mandatory features of SCSI-2
- Many of the optional features of SCSI-2
- Some of the mandatory and some of the optional features of SCSI-3.

When conflicts arise between the features of SCSI-2 and SCSI-3, the SCSI-2 methods have been chosen in all cases where execution would differ without explicit knowledge of the host. That is to say, if a command would act differently in SCSI-3 implementation without any difference in the actual Command Descriptor Block (CDB), the SCSI-2 functionality is used. If SCSI-3 defined a new functionality of a command but only with a new field or value for a field as defined by a SCSI-3 document, this functionality may have been implemented.

Please see individual command descriptions for the SCSI-3 features that have been implemented.

The Quantum Super DLTtape system supports the SCSI commands listed in Table 4-1.

Table 4-1. SCSI Commands Supported by Super DLTtape Drives

Command	Operation Code	Subsection
ERASE (19h)	19h	Page 4-15
INQUIRY (12h)	12h	Page 4-16
LOAD UNLOAD (1Bh)	1Bh	Page 4-30
LOCATE (2Bh)	2Bh	Page 4-32
LOG SELECT (4Ch)	4Ch	Page 4-34
LOG SENSE (4Dh)	4Dh	Page 4-41
MODE SELECT (6) / (10) (15h / 55h)	15h / 55h	Page 4-65
MODE SENSE (6) / (10) (1Ah / 5Ah)	1Ah / 5Ah	Page 4-100
PERSISTENT RESERVE IN (5Eh) (SCSI-3)	5Eh	Page 4-124
PERSISTENT RESERVE OUT (5Fh) (SCSI-3)	5Fh	Page 4-131
PREVENT / ALLOW MEDIUM REMOVAL (1Eh)	1Eh	Page 4-142
READ (08h)	08h	Page 4-143
READ BLOCK LIMITS (05h)	05h	Page 4-146
READ BUFFER (3Ch)	3Ch	Page 4-148
READ POSITION (34h)	34h	Page 4-153
RECEIVE DIAGNOSTIC RESULTS (1Ch)	1Ch	Page 4-158
RELEASE (10) (57h) (SCSI-3)	57h	Page 4-160
RELEASE UNIT (17h)	17h	Page 4-162
REPORT DENSITY SUPPORT (SCSI-3)	44h	Page 4-163
REPORT DEVICE IDENTIFIER (SCSI-3)	A3h	Page 4-168
REPORT LUNS (SCSI-3)	A0h	Page 4-170
REQUEST SENSE	03h	Page 4-172
RESERVE (10) (SCSI-3)	56h	Page 4-184
RESERVE UNIT	16h	Page 4-187

Table 4-1. SCSI Commands Supported by Super DLTtape Drives

Command	Operation Code	Subsection
REWIND	01h	Page 4-189
SEND DIAGNOSTIC	1Dh	Page 4-190
SET DEVICE IDENTIFIER (SCSI-3)	A4h	Page 4-191
SPACE	11h	Page 4-193
TEST UNIT READY	00h	Page 4-195
VERIFY	13h	Page 4-196
WRITE	0Ah	Page 4-197
WRITE BUFFER	3Bh	Page 4-199
WRITE FILEMARKS	10h	Page 4-203

NOTE: RESERVE UNIT and RELEASE UNIT by Logical Unit Number are supported, as are third-party reservations. Extent reservations are not supported.

Linked commands are supported.

The Super DLTtape drive does not act as an initiator on the SCSI bus. Therefore, the drive will not 1) generate unsolicited interrupts to the host, 2) initiate its own SCSI commands, or 3) assert bus RESET.

The RECEIVE DIAGNOSTIC RESULTS and SEND DIAGNOSTIC DATA commands implement vendor-specific pages to test the drive during the manufacturing process. It is recommended that initiators specify only the non-page format variants of these commands (PF=0), except for page 0x40.

4.1.1 SCSI Pointers

SCSI architecture provides a set of three pointers (called saved pointers) for each I/O process. The three pointers are: Command, Status, and Data. When an I/O process becomes active, the three saved pointers are copied to the initiator as current pointers. There is only one set of current pointers in the initiator at one time. The current pointers point to the next command, data, or status byte to be transferred between the initiator's memory and the drive. The saved and current pointers reside in the initiator.

The saved command pointer always points to the start of the Command Descriptor Block (CDB) for the I/O process. The saved status pointer always points to the start of the status area of the I/O process. The saved data pointer always points to the start of the data area until the drive sends a SAVE DATA POINTER message for the I/O process back to the initiator.

In response to the SAVE DATA POINTER message, the initiator stores the value of the current data pointer into the saved data pointer for that I/O process. The drive can restore the current pointer from the saved pointer value for the active I/O process by sending a RESTORE POINTERS message to the initiator. The initiator then copies the set of saved pointers into the set of current pointers. Whenever a drive disconnects from the SCSI Bus, only the set of saved pointers is retained in the initiator. The set of current pointers is restored from the set of saved pointers when the I/O process is reconnected.

4.1.2 Command Descriptor Block

An initiator communicates with the drive by sending a 6-, 10-, or 12-byte Command Descriptor Block (CDB) that contains the parameters for the specific command. The SCSI command's operation code is always the first byte in the CDB and a control field is the last byte. For some commands, the CDB is accompanied by a list of parameters sent during the DATA OUT phase. Figure 4-1 shows the format of a typical 6-byte CDB. Table 4-2 contains a description of the CDB fields.

Bit Byte	7	6	5	4	3	2	1	0
0	OpCode							
1	Logical Unit Number (LUN)			Unused or Command Specific				
2 - 3	Unused or Command Specific							
4	LSB of Transfer Length, Parameter List Length, or Allocation Length							
5	Control							
NOTE: Unless otherwise specified, all reserved bits indicated in the commands are 0.								

Figure 4-1. Typical 6-Byte Command Descriptor Block — Data Format

Table 4-2. Command Descriptor Block — Field Descriptions

Field	Description
Operation Code	The operation code specifies the command being requested. The list of supported SCSI commands and their operation codes are contained in Table 4-1.
Logical Unit Number	The Logical Unit Number (LUN) contains the number of the device being addressed. It must be set to 0. The LUN is ignored if the Command Descriptor Block is preceded by an IDENTIFY Message. In SCSI-3, the LUN field has been removed from the Command Descriptor Block. The LUN is established through the mandatory IDENTIFY message only.
Transfer Length	The transfer length field specifies the number of blocks (fixed block mode) or the number of bytes of a block (variable block mode), to be transferred between the initiator and the drive.

Table 4-2. Command Descriptor Block — Field Descriptions

Field	Description
Parameter List Length	The Parameter List Length is used to specify the number of bytes sent during the DATA OUT phase. This field is typically used for parameters that are sent to a drive (for example, mode, diagnostic, and log parameters). A parameter list length of 0 indicates that no data is to be transferred.
Allocation Length	The Allocation Length field specifies the number of bytes that the initiator has allocated for returned data. The Allocation Length is used to limit the amount of data returned to the initiator. An Allocation Length of 0 indicates that no data is to be transferred from the drive to the initiator. The drive terminates the DATA IN phase when the specified number of bytes have been transferred to the initiator or when all available data has been transferred, whichever is less.
Control Field	The Control Field is the last byte of every CDB. Its format is shown in Table 4-2.

Bit / Byte	7	6	5	4	3	2	1	0
5	Vendor Specific		Reserved				Flag	Link

Figure 4-2. Command Descriptor Block Control Field — Data Format

Table 4-3. Command Descriptor Block Control Field — Field Descriptions

Field	Description
Vendor Specific Bits	These bits can used to modify a command's operation in a vendor-specific manner. Commands with no vendor-specific features ignore these bits. Refer to individual command descriptions for information about how these bits are used.

Table 4-3. Command Descriptor Block Control Field — Field Descriptions

Field	Description
Flag Bit	The Flag bit is used in conjunction with the Link bit to notify the initiator in an expedient manner that a command has been completed. In SCSI-3, the Flag bit is no longer defined. This bit is reserved.
Link Bit	Setting the Link bit = 1 provides an automatic link to the next command, bypassing the usual ARBITRATION, SELECTION, and MESSAGE OUT phases that would normally occur between commands. A Link bit set to 1 indicates that the initiator requests continuation of a task (an I/O process) across two or more SCSI commands. If the Link bit is 1 and the Flag bit is 0, and the task completes successfully, the drive continues the task and returns a status of INTERMEDIATE and a LINKED COMMAND COMPLETE message. If the Link bit and the Flag bit within a Control word are both set to 1, and the drive completes a command with a status of INTERMEDIATE, the drive returns a LINKED COMMAND COMPLETE message (with Flag).

4.1.3 Status and Error Reporting

SCSI message-level errors are communicated by messages that are defined specifically for that purpose (for example, MESSAGE PARITY ERROR, MESSAGE REJECT). Message-level errors are also handled by drive-managed retries. Refer to Chapter 3, "SCSI Messages" for more detailed message-handling information.

SCSI command-level errors are communicated by a status code that is returned by the drive during the STATUS phase. This phase occurs at the end of each command, unless the command is terminated by one of the following events:

- ABORT message
- BUS DEVICE RESET message
- SCSI reset condition
- Unexpected disconnect.

The status code is contained in bits 1 through 5 of the status byte. Bits 0, 6, and 7 are reserved. Table 4-4 describes the status codes returned by the drive.

Table 4-4. Status Codes

Status Code	Definition	Meaning
00h	GOOD	The drive successfully completed the command.
02h	CHECK CONDITION	An exception condition has occurred and a Contingent Allegiance condition has been established.
08h	BUSY	The drive cannot service the command at the moment, and its CDB has been discarded. The initiator can retry the command at a later time.
10h	INTERMEDIATE GOOD	This status is returned instead of a GOOD status for commands issued with the LINK bit set. Following the return of this status, the drive proceeds to the COMMAND phase for the transfer of the next linked command.
18h	RESERVATION CONFLICT	Another initiator has reserved the drive when it has been reserved for another initiator with a RESERVE UNIT, RESERVE (10), or PERSISTENT RESERVE OUT command (this status is never returned for INQUIRY or REQUEST SENSE commands).

4.1.4 DATA Phase Command Components

Many of the SCSI commands cause data to be transferred between the initiator and the drive. The content and characteristics of this data are command-dependent. Table 4-5 lists the information transmitted for all of the commands.

The “Length in CDB” column of Table 4-5 identifies the Command Descriptor Block field used by the drive to determine how much command-related data are to be transferred. The units (bytes or logical blocks) for the different Length fields are implied by the Length Field Name as follows:

Field Name	Units Implied
Allocation Length	Bytes of data the drive is allowed to send to the initiator.
Parameter List Length	Bytes of data the initiator has available for the drive.
Transfer Length	Logical number of data blocks or data bytes the initiator wants transferred or verified.
Byte Transfer Length	Bytes of data the initiator wants transferred.

The DATA OUT column in Table 4-5 lists the information passed to the drive by the initiator as part of the command. The DATA IN column lists the information sent to the initiator by the drive. Numbers in parentheses after an item indicate the item's length in bytes. In some cases, additional length information is communicated during the DATA phase.

Table 4-5. DATA Phase Command Contents

Command	Length in CDB	Data Out (To Drive)	Data In (From Drive)
ERASE	0		
INQUIRY	Allocation	---	Standard Inquiry or a Vital Product Data page
LOAD UNLOAD	0	---	---
LOCATE	0	---	---
LOG SELECT	Parameter List (must be 0)	---	---
LOG SENSE	Allocation	---	Log Page
MODE SELECT (6) / (10)	Parameter List	Mode Parameter Header (4) Block Descriptor (8) Page(s)	---
MODE SENSE (6) / (10)	Allocation	---	Mode Parameter Header (4) Block Descriptor (8) Page(s)
PERSISTENT RESERVE IN	Allocation	---	Parameter Data
PERSISTENT RESERVE OUT	Parameter Length	Parameter List	---
PREVENT ALLOW MEDIUM REMOVAL	0	---	---
READ	Transfer	---	Data
READ BLOCK LIMITS	0	---	Block Length Limits
READ BUFFER	Allocation	---	Buffer Offset and Allocation Length and/ or Test Data
READ POSITION	Determined by Long Bit	---	Position Identifier or SCSI Logical Address

Table 4-5. DATA Phase Command Contents

Command	Length in CDB	Data Out (To Drive)	Data In (From Drive)
RECEIVE DIAGNOSTIC RESULTS	Allocation	---	Diagnostic Page
RELEASE (10)	Parameter List	Device ID	---
RELEASE UNIT	0	---	---
REPORT DENSITY SUPPORT	Allocation	---	Density Support Header(4), Density Support Descriptors
REPORT DEVICE IDENTIFIER	Allocation	---	Device Identification information
REPORT LUNS	Allocation	---	Supported LUNs List
REQUEST SENSE	Allocation	---	Sense Data
RESERVE (10)	Parameter List	Device ID	
RESERVE UNIT	0	---	---
REWIND	0	---	---
SEND DIAGNOSTIC	Parameter List	Diagnostic Page	---
SET DEVICE IDENTIFIER	Parameter List	Device ID	---
SPACE	0	---	---
TEST UNIT READY	0	---	---
VERIFY	0	---	---
WRITE	Transfer	Data	---
WRITE BUFFER	Parameter List	Microcode Image Data or Test Data	---
WRITE FILEMARKS	---	—	---

4.1.5 Unit Attention Condition

Queued Unit Attentions are implemented on the tape drive and are maintained separately for each valid LUN for each initiator. Unit Attentions are created in each of the following circumstances:

- At power-on
- At Bus Reset
- At Bus Device Reset message
- When the medium may have changed asynchronously
- When another initiator changes the Mode parameters
- When a firmware (microcode) update has completed
- Change of SCSI bus transceivers (SE or LVD)

Up to three Unit Attentions may be queued for each initiator. If an initiator does not clear its queued Unit Attentions, any additional Unit Attention conditions are not reported.

4.1.6 Behavior at Power-On

The following apply to the tape drive's behavior at power-on:

- The device's SCSI lines are set to high impedance.
- The design of the tape drive prevents it from generating any spurious signals on the SCSI bus during power-on.
- Within five seconds of power-on, the tape drive responds to SCSI bus selections and returns appropriate, normal responses. Tape motion commands will be returned with Check Condition status, sense key Not Ready, until the tape medium has been made ready.
- The tape is rewound to Beginning of Tape (BOT).
- The tape drive goes through a calibration process at power on and loading of media.
- The tape drive recognizes multiple, successive SCSI bus resets and SCSI bus resets of arbitrarily long duration. The tape drive recovers within the time limits specified above following the last SCSI bus reset.

4.1.7 Data Cache and Tape Write Interaction

The Quantum Super DLTtape drive contains a data cache that buffers blocks and filemarks until they are written to tape. This section describes what happens when those blocks are written, or "flushed" to tape. A MODE SELECT parameter allows the data cache to be disabled (unbuffered mode). In this mode, every WRITE command causes data to be written to the tape medium before the STATUS byte and the COMMAND COMPLETE message are returned to the host.

NOTE: Unbuffered mode is NOT recommended due to the poor performance that may result.

The contents of the write data cache are written to the tape medium under the following circumstances:

- When a WRITE FILEMARKS command is issued with the Immediate bit set to 0.
- When data has been in the cache longer than the maximum time specified by the value of the MODE SELECT parameter "Write Delay Time" (the default is 10 seconds).
- When a non-write-type media access command is received.
- When a SCSI reset condition occurs.

4.2 SCSI Command Descriptions

The SCSI command descriptions that make up the rest of this chapter contain detailed information about each command supported by the tape drive. The SCSI commands are presented in alphabetical order. Fields common to many of the SCSI commands are not repeated for every command; instead they are supported as follows:

Name of Field	How Field is Supported in SCSI Commands
Logical Unit Number	LUN for tape drive is 0.
Reserved	Reserved bits, fields, bytes, and code values are set aside for future standardization and must be set to 0. If the drive receives a command that contains non-zero bits in a reserved field or a reserved code value, the command is terminated with a CHECK CONDITION status and the sense key is set to ILLEGAL REQUEST.

Throughout this manual, multiple bytes that contain information about specific command parameters are portrayed as shown in the example of the Parameter List Length field (bytes 7 and 8) of the LOG SELECT command shown as follows:

Bit Byte	7	6	5	4	3	2	1	0
(Bytes 0 - 6)								
7 - 8	(MSB) Parameter List Length (LSB)							

As shown, this sample indicates that the most significant bit (MSB) of the field is bit 7 of byte 7; the least significant bit is bit 0 of byte 8.

This is an alternate, “shorthand” presentation for:

Bit Byte	7	6	5	4	3	2	1	0
(Bytes 0 - 6)								
7	(MSB)							
8	Parameter List Length							(LSB)

The shorthand version of presentation is used in this manual to save space.

4.3 ERASE Command (19h)

The ERASE command is used to erase the data on the tape medium. The data is erased only if the Long bit in the CDB is set to 1 and the ERASE command is received while the tape drive is at BOT. If the Long bit is not set, the command has no effect on the medium.

The time required to completely erase a Super DLTtape I is more than 3 hours.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (19h)							
1	Logical Unit Number			Reserved			Immed	Long
2 - 4	Reserved							
5	Unused		Reserved				Flag	Link

Figure 4-3. ERASE Command Descriptor Block — Data Format

Table 4-6. ERASE Command Descriptor Block — Field Descriptions

Field	Description
Immed	Immediate. If the Immediate bit = 0, the target does not return status until the selected operation has completed. If set to 1, status is returned as soon as the operation has been initiated.
Long	Must be set to 1 to perform an erase operation. Issuing an ERASE command when the tape is not at Beginning of Tape (BOT) is an ILLEGAL REQUEST. If the Long bit is set to 0, no operation is performed (the tape is unaffected by the ERASE operation).

4.4 INQUIRY Command (12h)

The INQUIRY command allows the initiator to determine the kind of SCSI devices attached to its SCSI Bus. It causes a device that is attached to a SCSI Bus to return information about itself. The drive identifies itself as a Sequential Access Storage Device that implements the SCSI-2 protocol. The drive does not need to access its tape medium to respond to the inquiry.

The drive can provide three categories of data in response to an INQUIRY command:

- Standard Inquiry Data — contains basic data about the drive.
- Vital Product Data — comprises several pages of additional data. Each Vital Product Data page requires a separate INQUIRY command from the initiator.
- Command Support Data — for a specified OpCode, indicates the fields in its Command Descriptor Block that are supported.

An INQUIRY command is not affected by, nor does it clear, a Unit Attention condition.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	Logical Unit Number			Reserved			CmdDt	EVPD
2	Page Code							
3	Reserved							
4	Allocation Length							
5	Unused		Reserved				Flag	Link

Figure 4-4. INQUIRY Command Descriptor Block — Data Format

Table 4-7. INQUIRY Command Descriptor Block — Field Descriptions

Field	Description
CmdDt	Command Support Data. If CmdDt = 0 and EVPD (see below) = 0, the drive returns the Standard Inquiry Data. If CmdDt = 1 with EVPD = 0, the drive returns the Command Data specified by Page Code/Operation. Information about Command Support Data is provided in Figure 4-12 and Table 4-13.
EVPD	Enable Vital Product Data. If EVPD = 0 and CmdDt (see above) = 0, the drive returns the Standard Inquiry Data. If EVPD = 1and CmdDt = 0, the drive returns the Vital Product Data Page specified by Page Code/Operation Code.
Page Code or Operation Code	Specifies the Vital Product Data Page which is to be returned by the drive when EVPD is set. Specifies the SCSI Operation Code for Command Support data to be returned by the drive when CmdDt is set. A CHECK CONDITION status is returned if this field specifies an unsupported Page or Operation Code or if both EVPD and CmdDt are set. Table 4-7 shows the Page Codes for the Vital Product Pages supported by the drive.
Allocation Length	Specifies the number of bytes of inquiry information the drive is allowed to return to the initiator during the command's DATA IN phase. Error status is not returned if the value in this field truncates the requested information.

4.4.1 Standard Inquiry Data Page

Figure 4-5 shows the format of the Standard Inquiry Data page returned by the drive.

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB	Device Type Modifier						
2	ISO Version		ECMA Version			ANSI Version		
3	AENC	TrmIOP	Reserved		Response Data Format			
4	Additional Length = 35h							
5	Reserved							
6	Reserved				MChngr	Reserved		Addr16
7	RelAdr	Wbus32	Wbus16	Sync	Linked	Rsv'd	CmdQue	SftRe
8 - 15	Vendor Identification (QUANTUM)							
16 - 31	Product Identification							
32 - 35	Product Revision Level (hhss)							
36 - 55	Vendor Specific Bytes							
56	Reserved				Clocking		QAS	IUS
57	Reserved							

Figure 4-5. Standard Inquiry Data Page — Data Format

The following table contains field descriptions for the data returned by the drive.

Table 4-8. Standard Inquiry Data Page — Field Descriptions

Field Name	Value	Description
Peripheral Qualifier	0	This field contains 000b if the LUN the command was directed to is valid. The field is 011b if there is no device at the selected LUN.
Peripheral Device Type	1	This field contains 1 if the LUN is 0h, 8h if the LUN selects an attached loader, or Fh if no device is attached to the selected LUN.
RMB	1	Removable Medium Bit. Set to 1.

Table 4-8. Standard Inquiry Data Page — Field Descriptions (Continued)

Field Name	Value	Description
Device Type Modifier	0	This vendor-specific field is set to 0.
ISO Version	0	International Standardization Organization Version level. Set to 0.
ECMA Version	0	European Computer Manufacturers Organization Version level. Set to 0.
ANSI Version	2	ANSI SCSI Level 2 (SCSI-2) is supported.
AENC	0	Asynchronous Event Notification is not supported.
TrmIOP	0	Terminate I/O Process. The tape drive does not support the TERMINATE I/O PROCESS message.
Response Data Format	2	This Standard Inquiry Data is in SCSI-2 format.
Additional Length	35h	Tape drive uses this field to indicate the number of additional bytes of INQUIRY Response Data available.
MChnger	-	This SCSI-3 bit indicates that the device is embedded in a tape automation system, either a library or a loader. If the SCSI3lnq EEPROM option is set to TRUE (default is FALSE) and the drive is in an automation system, this bit is set to 1. Otherwise, this bit is 0.
Addr16	0	Default value is 0. This SCSI-3 bit is set to 1 to indicate the drive supports 16-bit addresses. If the SCSI3Inq EEPROM option is set to TRUE (default is FALSE), this bit is set to 1. Otherwise, this bit is 0.
RelAdr	0	Relative addressing is not supported.
WBus 32	0	Set to 0 (since the drive does not support 32-bit transfer).
WBus 16	1	The WBus bit is 1 since the drive supports 16-bit data transfer.
Sync	1	The drive supports Synchronous Data Transfers.
Linked	1	The drive supports Linked Commands.
CmdQue	0	The drive does not support Tagged Command Queuing.
SftRe	0	The drive implements the hard reset option in response to assertion of the SCSI Bus reset line.
Vendor Identification		The value in this field is **QUANTUM** (the field is padded with space characters after the word Quantum).
Product Identification		For the SDLT 220, this field is set to “SuperDLT1.” For the SDLT 320, this field is set to “SDLT 320.”

Table 4-8. Standard Inquiry Data Page — Field Descriptions (Continued)

Field Name	Value	Description
Product Revision Level		This field contains 4 bytes of ASCII data that provides the drive's firmware revision levels. The first two bytes are the version number for servo code. The second two bytes are the version number of the SCSI/read/write code. When a firmware update is performed on the DLT drive, this portion of the revision level will change to reflect that update.
Vendor Specific		See "Vendor Specific Inquiry Data Page" for details.
Clocking		Indicates level of data clocking supported. Set to 00b to indicate only single edge transfers supported.
QAS		Quick Arbitrate Supported. Set to 0 to indicate QAS is not supported.
IUS		Information Units Supported. Set to 0 indicating Information Units are not supported.

NOTE: Vendor Information, Product Identification, and Product Revision Level are returned as shown in Section 4.4.2.

4.4.2 Vendor Specific Inquiry Data Page

The following information can be used to precisely identify the revision of subsystem components.

Bit / Byte	7	6	5	4	3	2	1	0
36	Product Family				Released Firmware			
37	Firmware Major Version #							
38	Firmware Minor Version #							
39	EEPROM Format Major Version #							
40	EEPROM Format Minor Version #							
41	Firmware Personality							
42	Firmware Subpersonality							
43	Vendor Specific Subtype							
44	Controller Hardware Version #							
45	Drive EEPROM Version #							
46	Drive Hardware Version #							
47	Media Loader Firmware Version #							
48	Media Loader Hardware Version #							
49	Media Loader Mechanical Version #							
50	Media Loader Present Flag							
51	Library Present Flag							
52 - 55	Module Revision							

Figure 4-6. Vendor Specific Inquiry Bytes — Definitions

Table 4-9. Vendor Specific Inquiry Data Page — Field Descriptions

Field Name	Description
Product Family	This field indicates the data density of each of the Super DLTtape drives as follows: **Value** — **Drive Density** 0h — Not specified 5h — 20.0 / 40.0 GB 7h — 35.0 / 70.0 GB 8h — 40.0 / 80.0 GB Ah — 110.0 / 220.0 GB Bh — 160.0 / 320.0 GB
Released Firmware	This flag differentiates between released and test versions of firmware. When set to 1, indicates released code (Vxxx); 0 indicates field test code (Txxx). Released code has no minor firmware version number (byte 38 = 0). For tracking purposes, field test and engineering versions of code have non-zero minor firmware version numbers.
Version #	These fields display the various version numbers in binary, not ASCII.
Vendor Specific Subtype	Identification of product.
Firmware Personality	Numeric indicator of firmware personality. Note that when set to 4, this indicates OEM family.
Firmware Subpersonality	Set to 1 indicates standard SCSI device firmware.
Loader Present	Set to 0 indicates no loader present. Non-zero indicates loader is present.
Library Present	Set to 0 indicates no library present. Non-zero indicates library is present.
Module Revision	A four byte ASCII string representing the revision level of the tape drive's module (the controller PCBA attached to the tape drive).

4.4.3 Vital Product Data Pages

The following subsections describe the Vital Product Data Pages for the system.

Supported Vital Product Data Page (00h)

The Supported Vital Product Data Pages page provides a directory of the Vital Product Data Pages that are supported by the drive. The pages that are supported are:

- Supported Vital Product Data Page (00h)
- Unit Serial Number Page (80h)
- Device Identification Page (83h)
- Firmware Build Information Page (C0h)
- Subsystem Components Revision Page (C1h) (Quantum use only)

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (00h)							
2	Reserved							
3	Page Length (5 or more bytes)							
4	00h - (this page)							
5	80h - Unit Serial Number Page							
6	83h - Device Identification Page							
7	C0h - Firmware Build Information Page (VS)							
8	C1h – Subsystem Components Revision Page (Quantum use only)							

Figure 4-7. Supported Vital Product Data Pages Page — Data Format

Unit Serial Number Page (80h)

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (80h)							
2	Reserved							
3	Page Length (0Ch)							
4 - 15	Serial Number							

Figure 4-8. Unit Serial Number Page — Data Format

Table 4-10. Unit Serial Number Page — Field Description

Field Name	Description
Serial Number	The serial number given is the serial number of the module or the drive—typically starting with "MX," indicating the site of manufacture. If the drive serial number is valid, then it is reported; otherwise, the module serial number is reported. The serial number can be found on the bar code label. The serial number is returned in ASCII.

Device Identification Page (83h)

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (83h)							
2	Reserved							
3	Page Length							
4 - n	Identification Descriptors							

Figure 4-9. Device Identification Page — Data Format

There are three different Identification Descriptors returned, in numerical order of the Identifier Type. Each identification descriptor takes the following form:

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved				Code Set			
1	Reserved		Association		Identifier Type			
2	Reserved							
3	Identifier Length (n-3)							
4 - n	Identifier							

Figure 4-10. Identifier Descriptor — Data Format

Table 4-11. Identifier Descriptor — Field Descriptions

Field Name	Description
Code Set	Indicates the type of data to be found in the Identifier field. A value of 1 indicates binary data. A value of 2 indicates ASCII data.
Association	Indicates whether the Identifier is associated with the logical unit or the port. Always contains a 0, indicating the Identifier is associated with the logical unit.
Identifier Type	Type of identifier: **Value** **Description** 1 Concatenation of the Vendor Name, Product ID, and unit serial number 2 Canonical form of the IEEE Extended Unique Identifier, 64 bit (EIU-64) 3 FC-PH Name_Identifier
Identifier	Identifier data, based on the Identifier Type.

The following table describes the identifiers supported by the Super DLTtape system.

Table 4-12. Supported Identifiers

Identifier Type	Code Set	Length	Identifier
1	2	24	This string varies based on the drive model: • An SDLT 320 returns: QUANTUM SDLT 320, 9 ASCII space characters (20h), followed by the unit serial number in ASCII. • An SDLT 220 returns: QUANTUM SuperDLT1, 7 ASCII space characters (20h), followed by the unit serial number in ASCII.
2	1	8	8 bytes of binary data indicating the EUI-64 assigned to the drive.
3	1	8	8 bytes of binary data indicating the 64-bit, type 5, FC-PH Name_Identifer assigned to the drive.

Firmware Build Information Page (C0h)

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (C0h)							
2	Reserved							
3	Page Length (28h)							
4 - 7	Servo Firmware Revision							
8 - 11	Servo Firmware Checksum							
12 - 15	Servo EEPROM Checksum							
16 - 19	Controller Firmware Checksum							
20 - 43	Controller Firmware Build Date							

Figure 4-11. Firmware Build Information Page — Data Format

Table 4-13. Firmware Build Information Page — Field Descriptions

Field Name	Description
Checksum	Servo Firmware, Servo EEPROM, and READ/WRITE Firmware checksums are provided as binary numbers and are for positive firmware and EEPROM identification.
FBD	Firmware Build Date. An ASCII string in the DD-MMM-YYYY HH:MM:SS format.

Subsystem Components Revision Page (C1h)

This page is for Quantum use only; page content is subject to change at any time.

4.4.4 Command Support Data Page

An application client can request Command Support data by setting the CmdDt bit of the INQUIRY command to 1, and specifying the SCSI operation code of the Command Descriptor Block (CDB) for which it wants information.

Format of the Command Support data, and definitions of the fields follow.

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Reserved					Support		
2	ISO Version		ECMA Version			ANSI - Approved Version		
3 - 4	Reserved							
5	CDB Size (n - 5)							
6 - n	CDB Usage Data							

Figure 4-12. Command Support Data Page — Data Format

Table 4-14. Command Support Data Page — Field Descriptions

Field Name	Description
Support	The value of this field describes the type of support that the tape drive provides for Command Support Data. **Value** — **Description** 001b — The device does not support the SCSI operation code requested. In this case, all data after Byte 1 is undefined. 011b — The device supports the SCSI operation code in conformance with the SCSI standard. 101b — The device supports the SCSI operation code, but in a vendor-specific manner.
ISO-Version	0
ECMA-Version	0
ANSI-Approved Version	2
CDB Size	This field contains the number of bytes in the CDB for the OpCode being requested and the size of the CDB Usage Data in the data that is returned in response to the INQUIRY command.
CDB Usage Data	This field contains information about the CDB for the OpCode being queried. Note that the first byte of the CDB Usage Data contains the OpCode for the operation specified. All of the other bytes of the CDB Usage Data contain a map for bits in the CDB of the OpCode specified.

The bits in the map have a 1-to-1 correspondence to the CDB for the OpCode being queried. That is to say, if the device senses a bit as the entire field or as part of the field of the operation, the map in CDB Usage Data contains a “1” in the corresponding bit position. If the device ignores a bit or declares a bit as “reserved” in the CDB for the OpCode being queried, the map has a “0” in that corresponding bit position.

4.5 LOAD UNLOAD Command (1Bh)

The LOAD UNLOAD command tells the target to load or unload the tape medium in the tape cartridge. If no cartridge is in the tape drive, both LOAD and UNLOAD return a CHECK CONDITION status with a NOT READY sense key set. Likewise, if the drive has received an UNLOAD command with the Immediate bit set and then it receives another command that would require tape motion or if it receives a TEST UNIT READY command, the drive returns a CHECK CONDITION STATUS with a NOT READY sense key set.

Before executing the LOAD UNLOAD command, any cached write data is written to the tape.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Bh)							
1	Logical Unit Number			Reserved				Immed
2 - 3	Reserved							
4	Reserved					EOT	Re-Ten	Load
5	Unused	ITD	Reserved				Flag	Link

Figure 4-13. LOAD UNLOAD Command Descriptor Block — Data Format

Table 4-15. LOAD UNLOAD Command Descriptor Block — Field Descriptions

Field Name	Description
Immed	Immediate. If this bit is set to 1, status is returned as soon as the operation is started. If set to 0, status is returned after the operation has completed.
EOT	End of Tape. This bit is ignored by the tape drive unless both the EOT and Load bits are set to 1, then the drive returns CHECK CONDITION, ILLEGAL REQUEST data.
Re-Ten	Re-tension. Re-tension operations are not needed on the tape drive. This bit is ignored.
Load	If the Load bit is set to 1, and the medium is already loaded, any cached write data is written to the tape and the tape is rewound. A “GOOD” status is returned. If the medium was unloaded but the cartridge was not removed, a LOAD command causes the tape to be loaded to Beginning of Partition (BOP) again and made ready. If the Load bit is set to 0, and the medium is loaded, the drive writes any buffered data and filemarks to the tape and then rewinds the tape to BOM and unloads the medium back into the cartridge. At that point, the drive will eject the medium if not in a library. If the drive is in a library, the drive does not eject, but waits for another command. If the medium is already unloaded, no action is taken. A GOOD status is returned.
ITD	Invalidate Tape Directory. The tape directory is written at the beginning of the tape; it contains information for each track to enhance the performance of the LOCATE and SPACE commands. Append operations not at EOD or within two tapemarks of EOD require that the directory be updated and marked invalid before the append is started. If the application wants to avoid the time required to invalidate the directory, it can set the ITD bit when the tape is loaded. When the ITD flag is set, the directory will be written and marked invalid as part of the load operation and the drive will remain in ITD mode until the tape is unloaded. While the drive remains in ITD mode, append operations will not require directory updates. The benefit of the ITD bit is performance on appends, the cost is that in some rare failure cases, the tape directory may be lost and have to be rebuilt by reading the entire tape.

4.6 LOCATE Command (2Bh)

The LOCATE command is used to do high-speed positioning to the specified block address.

The READ POSITION command may be used to obtain the block address associated with the current position on tape. The LOCATE command can then be used to position the tape back at the same logical position for high performance restore operations of particular blocks of data.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (2Bh)							
1	Logical Unit Number			Reserved		BT	CP	Immed
2	Reserved							
3 - 6	(MSB) Block Address (LSB)							
7	Reserved							
8	Partition							
9	Unused		Reserved				Flag	Link

Figure 4-14. LOCATE Command Descriptor Block — Data Format

Table 4-16. LOCATE Command Descriptor Block — Field Descriptions

Field Name	Description
BT	Block Type. This bit is ignored.
CP	Change Partition. Since multiple partitions are not supported, this bit must be set to 0.
Immed	Immediate. If this bit is set to 1, status is returned as soon as the operation is started. If set to 0, status is returned after the operation has completed.
Block Address	The Block Address field defines the SCSI Logical Block Address to which the media will be positioned. These addresses start at address 0 and include data blocks and filemarks.
Partition	Not applicable (see CP field above).

4.7 LOG SELECT Command (4Ch)

The LOG SELECT command allows the host to manage statistical information maintained by the tape drive about its own hardware parameters or about the installed tape medium. The description should be read in conjunction with the description of the LOG SENSE command that follows it and provides the user with information about log page format, parameters, and supported pages.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (4Ch)							
1	Logical Unit Number (0)			Reserved			PCR	SP
2	PC		Reserved					
3 - 6	Reserved							
7 - 8	(MSB) Parameter List Length (LSB)							
9	Unused		Reserved				Flag	Link

Figure 4-15. LOG SELECT Command Descriptor Block — Data Format

Table 4-17. LOG SELECT Command Descriptor Block — Field Descriptions

Field Name	Description
PCR	Parameter Code Reset. If this bit is set to 1 and the parameter list length is set to 0, all accumulated values of page codes 2, 3, and 32 are set to 0 and all threshold values are set to default. If PCR is set to 1 and the parameter list length is set to a non-zero value, the command terminates with a CHECK CONDITION status with sense key of ILLEGAL REQUEST and an additional sense code (ASC) of INVALID FIELD IN CDB. (See additional Note under SP (Save Page) below.)
SP	Save Page. Note: If PCR and SP are **both** set to 1, the command terminates with a CHECK CONDITION status with sense key of ILLEGAL REQUEST and an additional sense code (ASC) of INVALID FIELD IN CDB.

Table 4-17. LOG SELECT Command Descriptor Block — Field Descriptions

Field Name	Description
PC	Page Control. This field defines the type of parameter values to be selected: **Code** — **Type of Parameter Value** 00b — Current Threshold Values 01b — Current Cumulative Values 10b — Default Threshold Values 11b — Default Cumulative Values When the PC field is set to 10b and the Parameter List Length field is set to 0, then all Current Threshold Values are reset to the Default Threshold Values. When the PC field is set to 11b and the Parameter List Length field is set to 0, then all Current Cumulative Values are reset to the Default Cumulative Values. This is equivalent to clearing all log pages that can be cleared. **Note:** The PC bits are ignored if the PCR bit is set to 1.
Parameter List Length	This field specifies the length, in bytes, of the LOG SELECT parameter list to be transferred from the initiator to the target during the DATA OUT phase. A parameter list length of 0 indicates that no data is to be transferred. This condition is not considered an error.

4.7.1 Error Summary in LOG SELECT Command Descriptor Block

The following conditions constitute errors that are detected by the drive in relation to the CDB. The request sense data is set to Illegal Request - Invalid Field in CDB.

The conditions that constitute errors are:

- PCR bit is set to 1 and parameter list is not set to 0.
- Both PCR and SP are set to 1.
- A parameter list length that would cause a parameter within a valid page to be truncated or otherwise incompletely initialized.

4.7.2 Operation of LOG SELECT

The LOG SELECT command allows the initiator to modify and initialize parameters within the logs supported by the tape drive.

There are two ways to initialize the log parameters:

1. Set the PCR bit in the LOG SELECT Command Descriptor Block; this clears all parameters.

2. Specify the log page and parameter values as the log parameters to clear individual pages. The following pages can be cleared using this method:

Page Code	Page Description
02h	Write Error Count Page
03h	Read Error Count Page
32h	Compression Ratio Page

If multiple pages are sent during the DATA OUT phase, they must be sent in ascending order according to page code. Otherwise, the command terminates with a CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code set to INVALID FIELD IN PARAMETER LIST. The same status is returned if an unsupported Page Code appears in any header or if the specified page cannot be cleared.

4.7.3 LOG SELECT Page Format

Each log page begins with a 4-byte header followed by *n* number of log parameter blocks (one block for each parameter code). Each block, except for parameter code 05h is comprised of 8 bytes. The parameter block for code 05h is 12 bytes.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
1	Reserved							
2 - 3	(MSB) Page Length (LSB)							

Figure 4-16. LOG SELECT Log Page — Header Format

Table 4-18. LOG SELECT Log Page Header — Field Descriptions

Field Name	Description
Page Code	The Page Code specifies for which Log Page this LOG SELECT command is directed.
Page Length	The Page Length field specifies the total number of bytes contained in this log page, not including the four bytes that make up the header.

Bit Byte	7	6	5	4	3	2	1	0
0 -1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		Rsv'd	LP
3	Parameter Length							
4 - 7	(MSB) Parameter Value (LSB)							
NOTE: Byte 2 is also referred to the Parameter Control Byte; it comprises six control bits plus one bit that is reserved.								

Figure 4-17. LOG SELECT Log Page — Parameters Format

Table 4-19. LOG SELECT Log Parameters — Field Descriptions

Field Name	Description
Parameter Code	Parameter Codes supported for the READ/WRITE error counter pages are as follows: **Code** **Description** 00h Errors corrected with substantial delays 01h Errors corrected with possible delays 02h Total rewrites or rereads 03h Total errors corrected 04h Total times correction algorithm processed 05h Total bytes processed 06h Total uncorrected errors 8000h Vendor Specific **NOTE**: Parameter codes 00h, 01h, and 04h always have a value of 0. Parameter value for 05h is 8 bytes; the prameter length is set to 8.
DU	Disable Update. This bit is not defined for LOG SELECT; the target ignores any value in DU.

Table 4-19. LOG SELECT Log Parameters — Field Descriptions (Continued)

Field Name	Description
DS	Disable Save. Not supported. DS and Target Save Disable (TSD) must be set to 1. If DS and/or TSD are set to 0, command terminates with CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code set to INVALID FIELD IN PARAMETER LIST.
TSD	Target Save Disable. Not supported. TDS and DS must be set to 1. If TSD and/or DS are set to 0, command terminates with CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code set to INVALID FIELD IN PARAMETER LIST.
ETC	Enable Threshold Comparison. When set to 1, drive performs a comparison with threshold values once the cumulative value is updated. Comparison criteria is defined in Threshold Met Criteria (TMC). If the comparison is met and the RLEC bit of MODE SELECT / SENSE Control Page 0Ah is set to 1, then a UNIT ATTENTION is generated for all initiators. The additional sense code is set to THRESHOLD CONDITION MET. If the RLEC bit is 0 and the comparison is met, then UNIT ATTENTION is not generated.
TMC	Threshold Met Criteria. Once the criteria specified in this field is met and the ETC bit is 1 and the RLEC bit in MODE SENSE / SELECT Control Page is set to 1, then UNIT ATTENTION is generated for all initiators. The criteria for comparison are: **Code** — **Basis of Comparison** 00b — Every update of the cumulative value 01b — Cumulative value equal to threshold value 10b — Cumulative value not equal to threshold value 11b — Cumulative value greater than threshold value • The Default Threshold Values are the maximum values that each parameter can attain. • The Current Cumulative Values are the values computed since the last reset of the device (either via power-cycle, BUS DEVICE RESET, or SCSI RESET. • The Default Cumulative Values are the values to which each parameter is initialized at a reset condition. Default values are zero. • By default, Current Threshold Values = Default Threshold Values. Note that all types of parameter values are changeable via LOG SELECT.
LP	List Parameter. This bit should always be set to 0 to indicate parameter codes are treated as data counters.
Parameter Length	This field specifies the number of bytes of the parameter value.
Parameter Value	This field indicates the actual value of this log parameter.

4.7.4 Error Detection Summary in LOG SELECT Pages

The host issues a LOG SENSE command to initialize host-resident software that allows determination of:

- The log pages used by the drive.
- The parameter codes and length of each parameter.

The following conditions constitute errors in the parameter block that cause the drive to return CHECK CONDITION with sense data set to ILLEGAL REQUEST and additional send code INVALID FIELD IN PARAMETER LIST:

- A page header is received with unsupported page codes.
- An incorrect log page length is specified in the page header.
- An illegal parameter code is contained in a valid page code.
- Parameter codes for a supported page are not sent in ascending order.
- The LP bit is set to 1 in the parameter control byte.
- The DS bit is set to 0 in the parameter control byte.
- The TSD bit is set to 0 in the parameter control byte.

4.8 LOG SENSE Command (4Dh)

The LOG SENSE command allows the host to retrieve statistical information maintained by the tape drive about its own hardware parameters or about the installed tape medium. It is a complementary command to LOG SELECT.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (4Dh)							
1	Logical Unit Number (0)			Reserved			PPC	SP(0)
2	PC		Page Code					
3 - 4	Reserved							
5 - 6	(MSB) Parameter Pointer (LSB)							
7 - 8	(MSB) Allocation Length (LSB)							
9	Unused		Reserved				Flag	Link

Figure 4-18. LOG SENSE Command Descriptor Block — Data Format

Table 4-20. LOG SENSE Command Descriptor Block — Field Descriptions

Field Name	Description
PPC	Parameter Pointer Control. A PPC of 0 indicates that the parameter data requested from the device starts with the parameter code specified in the Parameter Pointer field (Bytes 5 - 6) and return the number of bytes specified in the Allocation Length field (Bytes 7 - 8) in ascending order of parameter codes from the specified log page. When set to 1, only the parameters that have changed since the last time the page was read are returned.
SP	Save Parameters. Not supported, must be set to 0. If for some reason the Save Parameters bit is set, the command terminates with a CHECK CONDITION status with a sense key of ILLEGAL REQUEST and an ASC of INVALID FIELD IN CDB.

Table 4-20. LOG SENSE Command Descriptor Block — Field Descriptions

Field Name	Description
PC	Page Control. This field defines the type of parameter values to be returned: **Code** — **Type of Parameter Values** 00b — Threshold Values 01b — Cumulative Values 10b — Default Threshold Values 11b — Default Cumulative Values The Default Threshold Values are the maximum values that each parameter can attain. The Current Cumulative Values are the values computed since the last reset of the device (either via power-cycle, BUS DEVICE RESET, or SCSI RESET). The Default Cumulative Values are the values to which each parameter is initialized at a reset condition. Default values are zero. By default, Current Threshold Values = Default Threshold Values.
Page Code	The Page Code field identifies which log page is being requested by the initiator. If the page is not supported, then the command terminates with a CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code of INVALID FIELD IN CDB. Supported pages are: **Code** — **Page Definition** 00h — Supported Pages Log Page — Page 4-44 02h — Write Error Counter Page — Page 4-45 03h — Read Error Counter Page — Page 4-45 07h — Last n Errors Events Page — Page 4-49 0Dh — Temperature Page — Page 4-51 2Eh — TapeAlert Page — Page 4-53 32h — Compression Ratio Page — Page 4-56 33h — Device Wellness Log Page — Page 4-60 3Eh — Device Status Page — Page 4-62

Table 4-20. LOG SENSE Command Descriptor Block — Field Descriptions

Field Name	Description
Parameter Pointer	The Parameter Pointer field allows the host to specify at which parameter within a log page the requested data should begin. For example, if a page supports parameters 0 through 5, and the Parameter Pointer contains 3, then only parameters 3, 4, and 5 are returned to the initiator. Similarly, if a page supports parameters 1, 3, and 6, and the Parameter Pointer contains 2, then only parameters 3 and 6 are returned to the initiator. If the Parameter Pointer is larger than the highest numbered parameter on the page, then the target terminates the command with CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code set to INVALID FIELD IN CDB. Note that parameters within a page are always returned in ascending order according to parameter code. If the target does not support a parameter code within this page then it does not return any data associated with this parameter.
Allocation Length	This field specifies the maximum number of bytes that the initiator has allocated for returning data. The host uses this field to limit the size of data transfers to its own internal buffer size.

4.8.1 Error Summary in LOG SENSE Command Descriptor Block

The following conditions constitute errors detected by the drive relating to the LOG SENSE Command Descriptor Block. The request sense data is set to Illegal Request - Invalid Field in CDB.

Error conditions occur when:

- A page is not supported.
- The parameter pointer is larger than the highest numbered parameter on the page.
- The SP bit is set to 1.

4.8.2 Supported Pages Log Page (Page 00h)

When page 00h is requested, the 4-byte page header is returned, followed by the pages supported in ascending order, one byte for each.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (00h)					
1	Reserved							
2 - 3	(MSB) Page Length (09h) (LSB)							
4	00h							
5	02h							
6	03h							
7	07h							
8	0Dh							
9	2Eh							
10	32h							
11	33h							
12	3Eh							

Figure 4-19. Supported Pages Page — Data Format

4.8.3 Read (Page 03h) / Write (Page 02h) Error LOG SENSE Page

Each Log page begins with a 4-byte header followed by a number of log parameters.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
1	Reserved							
2 - 3	(MSB) Page Length (LSB)							

Figure 4-20. Read / Write Error LOG SENSE — Header Format

Table 4-21. Read / Write Error LOG SENSE Header — Field Descriptions

Field Name	Description
Page Code	The Page Code echoes the page code that was specified in the LOG SENSE Command Descriptor Block.
Page Length	The Page Length field specifies the total number of bytes contained in this log page, not including the four bytes that make up the header.

Bit / Byte	7	6	5	4	3	2	1	0
0 -1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		Rsv'd	LP
3	Parameter Length							
4 - n	(MSB) Parameter Value (LSB)							
Note: Byte 2 is also referred to the Parameter Control Byte; it comprises six control bits plus one bit that is reserved.								

Figure 4-21. Log Parameters Format for Read / Write Error LOG SENSE Page

Table 4-22. Log Parameters for Read / Write Error LOG SENSE Page — Field Descriptions

Field Name	Description
Parameter Code	Parameter Codes supported for the READ/WRITE error counter pages are as follows: **Code** — **Description** 0000h — Errors corrected with substantial delays 0001h — Errors corrected with possible delays 0002h — Total rewrites or rereads 0003h — Total errors corrected 0004h — Total times correction algorithm processed 0005h — Total bytes processed 0006h — Total uncorrected errors 8000h — WRITE errors since last READ (page 02) OR READ errors since last WRITE (page 03) 8001h — Total raw error count 8002h — Total dropout error count 9000h-9007h — Total raw errors per channel (8 channels) 9080h-9087h — Total overwrites per channel (8 Channels) Page 2 Only Parameter codes 00h, 01h, and 04h always return a value of 0.
DU	Disable Update. This field with a value 0 indicates that the target will update all log parameter values. This field set to 1 indicates that the target will not update the log parameter values except in response to LOG SELECT. This bit is set by the drive when accumulated values reach maximum. This is also returned set to 1 if the host set the bit in the last LOG SELECT command. Default is 0. Note that for parameter types other than threshold and cumulative values, this bit is always 0.
DS	Disable Save. Not supported; always set to 1.
TSD	Target Save Disable. Not supported; always set to 1.
ETC	Enable Threshold Comparison. When set to 1, indicates that comparison to threshold is performed. ETC of 0 indicates that the comparison is not performed. This bit is set to 1 by the Control Mode Page of MODE SELECT. Default is 0.

Table 4-22. Log Parameters for Read / Write Error LOG SENSE Page — Field Descriptions (Continued)

Field Name	Description
TMC	Threshold Met Criteria. This field is valid only if host sets ETC to 1. It determines the basis for comparison and is specified by host using LOG SELECT. If the result of comparison is true (cumulative = threshold), and MODE SELECT / SENSE Control Mode Page RLEC bit is set to 1, then a UNIT ATTENTION is granted for all initiators. The sense key is set to UNIT ATTENTION, the additional sense code to LOG EXCEPTION, and ASCQ is set to THRESHOLD CONDITION MET. If the RLEC bit in Control Mode Page is 0, then UNIT ATTENTION is not generated. Note that comparison is performed in real time. A LOG SENSE command need not be issued to get the check condition. Once ETC is selected, RLEC bit in Control Mode Page, the check condition is issued based on the criteria defined in the TMC bits if the criteria is met in real time. Check condition will not identify for which parameter code the criteria is met. Log Sense must be issued to read the counters to determine for which parameter code criteria has been met. The criteria for comparison are: **Code** — **Basis of Comparison** 00b — Every update of the cumulative value. 01b — Cumulative value equal to threshold value. 10b — Cumulative value not equal to threshold value. 11b — Cumulative value greater than threshold value.
LP	List Parameter. This bit is 0 since the parameter codes are treated as data counters.
Parameter Length	This field specifies the number of bytes of the parameter value. All parameters are 4 bytes in length except parameter 0005h, which is 8 bytes.
Parameter Value	This field indicates the actual value of this log parameter.

4.8.4 LAST n ERROR EVENTS Page (07h)

This page returns one parameter at a time that contains the ASCII text for the specified event log. The Parameter Number field in the Command Descriptor Block specifies the log event to return. The log events in EEPROM are numbered from 0 to 255, after which the number wraps back to 0; only a limited number of events are stored at a given time (up to 32). The log event that is returned is the one whose Parameter Code is equal to, or the first one greater than, the Parameter Number specified in the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (07h)					
1	Reserved							
2 - 3	(MSB) Page Length (LSB)							

Figure 4-22. Last n Error Events LOG SENSE — Header Format

Table 4-23. Last n Error Events LOG SENSE Header — Field Descriptions

Field Name	Description
Page Code	The Page Code echoes the page code that was specified in the LOG SENSE Command Descriptor Block.
Page Length	The Page Length field specifies the total number of bytes contained in this log page, not including the four bytes that make up the header.

Bit Byte	7	6	5	4	3	2	1	0
0 - 1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		Rsv'd	LP
3	Parameter Length							
4 - n	(MSB) ASCII String for Event n (LSB)							

Figure 4-23. Log Parameters Format for Last n Error Events LOG SENSE Page

Table 4-24. Log Parameters for Last n Error Events LOG SENSE Page — Field Descriptions

Field Name	Description
Parameter Code	Parameter Code values are assigned from 0 to 63 (decimal), where 0 is the oldest event stored and the highest Parameter Code returned is the most recent event.
ASCII String for Event n	The text of the parameter includes a "Packet #" that is a value from 0 to 255. This internal number is assigned when the packet is written to EEPROM. A value of 0 is normally the oldest packet, but packet numbers can wrap around back to 0 after reaching 255.

4.8.5 Temperature Page (0Dh)

In SCSI-3, this page is defined as a standardized way to report the device temperature. The page contains two parameters—the current temperature and the threshold temperature.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (0Dh)					
1	Reserved							
2 - 3	(MSB) Page Length (LSB)							

Figure 4-24. Temperature Page LOG SENSE — Header Format

Table 4-25. Temperature LOG SENSE Header — Field Descriptions

Field Name	Description
Page Code	The Page Code echoes the page code that was specified in the LOG SENSE Command Descriptor Block.
Page Length	The Page Length field specifies the number of bytes available and depends on the parameters requested.

Bit Byte	7	6	5	4	3	2	1	0
0 - 1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		LBIN	LP
3	Parameter Length (2)							
4 - 5	(MSB) Parameter Value (LSB)							

Figure 4-25. Log Parameters Format for Temperature Page

Table 4-26. Temperature LOG SENSE Parameters — Field Descriptions

Field Name	Description
Parameter Code	Parameter codes supported for the TEMPERATURE page are as follows: **Code** **Description** 0 Current temperature in degrees Celsius 1 Maximum operating temperature in degrees Celsius
DU	Disable Update. Always 0.
DS	Disable Save. Not supported. This bit always set to 1.
TSD	Target Save Disable. Not supported. This bit always set to 0.
ETC	Enable Threshold Comparison. Threshold checking is not supported on this page. Always set to 0.
TMC	Threshold Met Criteria. Always 0.
LBIN	List Binary. Always set to 1.
LP	List Parameter. Always set to 1 (parameter codes treated as data counter).

4.8.6 TapeAlert Page (2Eh)

This page returns results of the tape drive's on-going self-diagnosis, so that the tape drive's behavior can be monitored and high reliability ensured. The TapeAlert page is typically read from the tape drive at the beginning of each READ/WRITE activity, after any fatal errors occur during a READ/WRITE, at the end of any tape cartridge when the READ/WRITE activity continues onto another tape cartridge, and at the end of each READ/WRITE activity. The flags are set or cleared by the tape drive when the failure or corrective action occurs.

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (2Eh)							
1	Reserved							
2 - 3	(MSB) Page Length (LSB)							

Figure 4-26. TapeAlert LOG SENSE — Header Format

Table 4-27. TapeAlert LOG SENSE Header — Field Descriptions

Field Name	Description
Page Code	The Page Code echoes the page code that was specified in the LOG SENSE Command Descriptor Block.
Page Length	The Page Length field specifies the total number of bytes contained in this log page, not including the four bytes that make up the header.

Bit Byte	7	6	5	4	3	2	1	0
5*n* –1 to 5*n*	(MSB) Parameter Code (*n*) (LSB)							
5*n* + 1	DU	DS	TSD	ETC	TMC		Rsv'd	LP
5*n* + 2	Parameter Length (1)							
5*n* + 3	Value of TapeAlert Flag (Flag is set when Bit 0 = 1; Bits 1 – 7 are Reserved)							

Figure 4-27. TapeAlert Page Log — Parameters Format

Table 4-28. TapeAlert Page LOG SENSE Parameters — Field Descriptions

Field Name	Description
Parameter Code	This field contains the Flag code. See Table 4-29 on page 4-55 for the supported flags, level of severity, and the flags' definitions.
Parameter Length	This field is set to 1.
Value of TapeAlert Flag	If Bit 0 is set to 1, indicates that TapeAlert has sensed a problem. See Table 4-29 on page 4-55 for the supported flags and their definitions. If Bit 0 is 0, the flag is not set and no problem has been sensed.

For definitions of bits that make up the Control Byte (the byte "5n + 1" above), refer to "Read (Page 03h) / Write (Page 02h) Error LOG SENSE Page" on page 4-45.

Table 4-29. TapeAlert Flags, Severity Levels, and Meanings

Flag	Severity Level *	Meaning
1 Read Warning	Warning	Problems reading data. There is no loss of data, but the tape drive's performance is reduced.
2 Write Warning	Warning	Problems writing data. There is no loss of data, but the capacity of the tape is reduced.
3 Hard Error	Warning	An error has occurred during a read or write operation that the tape drive cannot correct: operation has stopped.
5 Read Failure	Critical	The tape medium or the tape drive is damaged. Contact a service representative.
6 Write Failure	Critical	The tape medium is faulty or the tape drive is damaged. Test the tape drive using a known-good tape cartridge. If the problem persists, contact a service representative.
9 Write Protect	Critical	The tape cartridge is write protected. Set the write protection switch to enable writing, or use a different tape cartridge.
10 No Removal	Informational	The tape drive is busy and the tape cartridge cannot be ejected. Wait for the operation to complete before attempting to eject the tape cartridge.
11 Cleaning Media	Informational	The tape cartridge in the tape drive is a cleaning cartridge. For normal tape drive data-related operations, replace the cleaning cartridge with a data tape cartridge.
17 Read Only Format	Warning	The type of tape currently loaded into the drive is Read Only on the SDLT 220/320.
20 Clean Now	Critical	The tape drive needs to be cleaned. Make sure that all tape operations have completed, eject the data tape cartridge and follow the appropriate steps to use a cleaning cartridge.
22 Expired Cleaning Media	Critical	The cleaning cartridge that was used has expired. Wait for all tape drive operations to complete, then use a valid cleaning cartridge for cleaning.
31 Hardware B	Critical	The tape drive may have a hardware fault. Contact a service representative.
32 Interface	Warning	The drive has identified a problem with the interface to/ from the host.

Table 4-29. TapeAlert Flags, Severity Levels, and Meanings (Continued)

Flag	Severity Level *	Meaning
34 Download Fail	Warning	The attempted firmware download has failed.
36 Drive Temperature	Warning	Temperature within the tape drive is exceeding the allowable specifications.
51 Tape Directory Invalid at Unload	Warning	A WRITE error prevented the directory from being updated when the tape was unloaded.

* Severity levels are *Informational*, *Warning*, and *Critical*. Informational flags provide a status-type message, Warning flags indicate that there is the possibility of loss of data, and Critical flags indicate the possibility of loss of data and that user intervention and/or service call may be required.

4.8.7 Read / Write Compression Page (32h)

This page begins with a 4-byte header followed by the log parameter blocks of 6 or 8 bytes, depending on the parameter code selected.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (32h)					
1	Reserved							
2 - 3	(MSB) Additional Length (LSB)							

Figure 4-28. Read / Write Compression Ratio LOG SENSE — Header Format

Table 4-30. Read / Write Compression Ratio LOG SENSE Header — Field Descriptions

Field Name	Description
Page Code	The Page Code echoes the page code that was specified in the LOG SENSE Command Descriptor Block.
Additional Length	The Additional Length field specifies the number of bytes available and depends on the parameters requested.

Bit Byte	7	6	5	4	3	2	1	0
0 -1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		Rsv'd	LP
3	Parameter Length (02h)							
4 - 5	(MSB) Compression Ratio x 100 (LSB)							

Figure 4-29. Log Parameters Format for Read / Write Compression Ratio LOG SENSE Page (Parameter Codes 00h and 01h)

Table 4-31. Log Parameters for Read / Write Compression Ratio LOG SENSE Page — Field Descriptions (Parameter Codes 00h and 01h)

Field Name	Description
Parameter Code	Parameter codes supported for the READ / WRITE COMPRESSION RATIO page are as follows (for codes 00h and 01h only; codes 02h through 09h are detailed separately): **Code** — **Description** 00h — READ Compression Ratio x 100 01h — WRITE Compression Ration x 100
DU	Disable Update. Always 0.
DS	Disable Save. Not supported. This bit always set to 1.
TSD	Target Save Disable. Not supported. This bit always set to 1.
ETC	Enable Threshold Comparison. Threshold checking is not supported on this page. Always set to 0.
TMC	Threshold Met Criteria. Always 0.
LP	List Parameter. Always set to 0 (parameter codes treated as data counter).

Bit Byte	7	6	5	4	3	2	1	0
0 - 1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		Rsv'd	LP
3	Parameter Length (04h)							
4 - 7	(MSB) Counter Value (LSB)							

Figure 4-30. Log Parameters Format for Read / Write Compression Ratio LOG SENSE Page (Parameter Codes 02h through 09h)

Table 4-32. Log Parameters for Read / Write Compression Ratio LOG SENSE Page — Field Descriptions (Parameter Codes 02h through 09h)

Field Name	Description
Parameter Code	Parameter codes supported for the READ / WRITE COMPRESSION RATIO page (codes 02h through 09h) are as follows: **Code** — **Description** 02h — Mbytes Transferred to Host 03h — Bytes Transferred to Host 04h — Mbytes Read from Tape 05h — Bytes Read from Tape 06h — Mbytes Transferred from Host 07h — Bytes Transferred from Host 08h — Mbytes Written to Tape 09h — Bytes Written to Tape
DU	Disable Update. Always 0.
DS	Disable Save. Not supported. This bit always set to 1.
TSD	Target Save Disable. Not supported. This bit always set to 1.
ETC	Enable Threshold Comparison. Threshold checking is not supported on this page. Always set to 0.

Table 4-32. Log Parameters for Read / Write Compression Ratio LOG SENSE Page — Field Descriptions (Parameter Codes 02h through 09h) (Continued)

Field Name	Description
TMC	Threshold Met Criteria. Always 0.
LP	List Parameter. Always set to 0 (parameter codes treated as data counter).
Counter Value	Parameter codes 02h through 09h provide a count of the number of bytes transferred since the last time the counters were reset via a LOG SELECT or SCSI reset condition. Parameter Codes 02h and 03h — Report the count of bytes transferred from the tape drive to the initiator. Parameter code 02h reports the number of full megabytes transferred; parameter code 03h reports the number of bytes less than a full megabyte that have been transferred. Multiplying the counter returned for parameter code 02h by 1,048,576 and then adding the value of the counter returned by parameter code 03h results in the actual total bytes transferred to the initiator. Parameter Codes 04h and 05h — Report the count of bytes transferred from the tape drive to the buffer. Parameter code 04h reports the number of full megabytes transferred; parameter code 05h reports the number of bytes less than a full megabyte that have been transferred. Multiplying the counter returned for parameter code 04h by 1,048,576 and then adding the value of the counter returned by parameter code 05h results in the actual total bytes transferred from tape to the buffer. Parameter Codes 06h and 07h — Report the count of bytes transferred from the initiator to the buffer. Parameter code 06h reports the number of full megabytes transferred; parameter code 07h reports the number of bytes less than a full megabyte that have been transferred. Multiplying the counter returned for parameter code 06h by 1,048,576 and then adding the value of the counter returned by parameter code 07h results in the actual total bytes transferred from the initiator to the buffer. Parameter Codes 08h and 09h — Report the count of bytes written to the tape drive. Parameter code 08h reports the number of full megabytes transferred; parameter code 09h reports the number of bytes less than a full megabyte that have been transferred. Multiplying the counter returned for parameter code 08h by 1,048,576 and then adding the value of the counter returned by parameter code 09h results in the actual total bytes written to the tape drive.

4.8.8 Device Wellness Page (33h)

The Device Wellness Page returns information about any check conditions related to Sense Keys 3h, 4h, 9h, and Bh logged by the tape drive. Up to 16 entries (parameter code 0000h to 000Fh) can be contained in the page. Note that parameter code 0000h contains the oldest log information while parameter 000Fh contains the most recent.

This page begins with a 4-byte header followed by the log parameter blocks, as shown in Figure 4-31.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (33h)					
1	Reserved							
2 - 3	(MSB) Page Length (LSB)							

Figure 4-31. Device Wellness LOG SENSE — Header Format

Table 4-33. Device Wellness LOG SENSE Header — Field Descriptions

Field Name	Description
Page Code	The Page Code field echoes the page code that was specified in the LOG SENSE Command Descriptor Block.
Page Length	The Page Length field specifies the number of bytes available and depends on the parameters requested.

Bit Byte	7	6	5	4	3	2	1	0
0-1	Parameter Code							
2	DU	DS	TSD	ETC	TMC		Rsv'd	LP
3	Parameter Length (0Ch)							
4 - 7	(MSB) Time Stamp (LSB)							
8 - 11	(MSB) Media ID (LSB)							
12	Sense Key							
13	Additional Sense Code							
14	Additional Sense Code Qualifier							
15	Additional Error Information							

Figure 4-32. Log Parameters Format for Device Wellness LOG SENSE Page (Parameter Codes 0000h – 000Fh)

Table 4-34. Log Parameters for Device Wellness LOG SENSE Page — Field Descriptions

Field Name	Description
Parameter Code	Parameter codes 0000h through 000Fh are supported. This provides 16 log entries for error information capture.
DU	Disable Update. Always 0.
DS	Disable Save. Not supported. This bit always set to 1.
TSD	Target Save Disable. Not supported. This bit always set to 1.
ETC	Enable Threshold Comparison. Threshold checking is not supported on this page. Always set to 0.
TMC	Threshold Met Criteria. Always 0.
LP	List Parameter. Always set to 0.

Table 4-34. Log Parameters for Device Wellness LOG SENSE Page — Field Descriptions (Continued)

Field Name	Description
Time Stamp	Power-on hours when check condition occurred (note that this is the number of power-on hours since the last time the unit was powered on, not total number of hours during the lifetime of the drive). The time stamp counter is updated once per hour; if the tape drive is powered down before the hourly update occurs, the update will not occur until a full hour after power is re-applied.
Media ID	Internal media identifier being used when check condition occurred. 0 indicates no media or unknown media when event occurred. Note that this is not a legitimate method of tracing media.

4.8.9 Device Status Page (3Eh)

The Device Status Page describes the current status of the tape drive.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (3Eh)					
1	Reserved							
2 - 3	(MSB) Page Length (LSB)							

Figure 4-33. Device Status LOG SENSE — Header Format

Table 4-35. Device Status LOG SENSE Header — Field Descriptions

Field Name	Description
Page Code	The Page Code field echoes the page code that was specified in the LOG SENSE Command Descriptor Block.
Page Length	The Page Length field specifies the number of bytes available and depends on the parameters requested.

Bit Byte	7	6	5	4	3	2	1	0
0 - 1	Parameter Code							
2	DU	DS	TSD	ETC	TMC		Rsv'd	LP
3	Parameter Length (04h)							
4 - 7	(MSB) Parameter Value (LSB)							

Figure 4-34. Log Parameters Format for Device Status LOG SENSE Page

Table 4-36. Log Parameters for Device Status LOG SENSE Page — Field Descriptions

Field Name	Description
Parameter Code	Parameter Codes 0000h through 0005h are supported: **Code** **Description** 0000h Specifies device type. For sequential-type devices such as tape drives, the value is always 00010000h. 0001h Specifies device cleaning-related status (see Figure 4-35). 0002h Specifies the number of "loads" over the lifetime of the tape drive. 0003h Specifies the number of cleaning sessions per cartridge. 0004h Vendor specific. 0005h Drive temperature in degrees C. 0006h Media ID of the most recently loaded cartridge. 0007h Controller Serial Number (least significant 16 bits). This value is used to generate the Media ID on blank tapes. 0008h Tape drive cleaning cycle count.
DU	Disable Update. Always 0.
DS	Disable Save. Not supported. This bit always set to 1.
TSD	Target Save Disable. Not supported. This bit always set to 1.
ETC	Enable Threshold Comparison. Threshold checking is not supported on this page. Always set to 0.

Table 4-36. Log Parameters for Device Status LOG SENSE Page — Field Descriptions (Continued)

TMC	Threshold Met Criteria. Always 0.
LP	List Parameter. Always set to 0 (parameter codes treated as data counter).

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved					ClnQ	ClnR	ClnEx
1 - 3	(MSB) Reserved (LSB)							

Figure 4-35. Cleaning-Related Log Parameters Format for Device Status LOG SENSE Page

Table 4-37. Log Parameters for Device Status LOG SENSE Parameter 0001h (Cleaning-Related) — Field Descriptions

Field Name	Description
ClnQ	Set to 1 if a cleaning required condition exists. When the condition clears, this status is also cleared.
ClnR	Set to 1 if a cleaning request condition exists. When the condition clears, this status is also cleared.
ClnEx	Set to 1 if the cleaning tape has expired. If no cleaning tape is installed, this bit is cleared.

4.9 MODE SELECT (6) / (10) Command (15h / 55h)

The MODE SELECT commands enable the host to configure the tape drive. Before configuring the drive, the host should issue a MODE SENSE command to the drive to obtain a report of the current configuration and determine what parameters are configurable. The host interprets this information and then may issue MODE SELECT to set the drive to the host's preferred configuration. The Mode Parameter List (described in "Mode Parameter List" on page 4-68) is passed from the initiator to the drive during the command's DATA OUT phase.

Operating parameters for the drive are contained in several pages. The following table lists the MODE SELECT pages supported and the location of the manual sections detailing each page:

Page Code	Description	Refer to
01h	Read / Write Error Recovery Page	Page 4-74
02h	Disconnect / Reconnect Page	Page 4-76
0Ah	Control Mode Page	Page 4-78
0Fh	Data Compression Page	Page 4-80
10h	Device Configuration Page	Page 4-82
11h	Medium Partition Page	Page 4-85
1Ch	TapeAlert Page	Page 4-86
25h	Vendor Specific Configuration Page	Page 4-89
3Ch	Disaster Recovery Control Page	Page 4-91
3Eh	EEPROM Vendor Specific Page	Page 4-91

Except for EEPROM Vendor Specific (page 3Eh), the tape drive always powers on with its default configurations set. This is also true if the drive receives a BUS DEVICE RESET message or a reset via the RST line on the SCSI bus.

NOTE: See "Changeable Parameters Within MODE SELECT" on page 4-99 for a list of changeable parameters within MODE SELECT. See "EEPROM Vendor Specific Page (3Eh)" on page 4-123 for additional information about how to use (and change) these changeable parameters.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (15h)							
1	Logical Unit Number			PF	Reserved			SP (0)
2 - 3	Reserved							
4	Parameter List Length							
5	Unused		Reserved				Flag	Link

Figure 4-36. MODE SELECT (6) Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (55h)							
1	Logical Unit Number			PF	Reserved			SP (0)
2 - 6	Reserved							
7 - 8	Parameter List Length							
9	Unused		Reserved				Flag	Link

Figure 4-37. MODE SELECT (10) Command Descriptor Block — Data Format

Table 4-38. MODE SELECT (6)/(10) Command Descriptor Block — Field Descriptions

Field Name	Description
PF	Page Format. The Page Format bit indicates that the data sent by the host after the MODE SELECT header and block descriptors complies with the definition of pages in the SCSI-2 specification. If the Page Format bit is set to 0, only a Mode Parameter Header and Mode Parameter Block Descriptor may be included in the mode parameter data. If any other data is included in the mode parameter data, the drive will report an ILLEGAL REQUEST, INVALID FIELD IN CDB.
SP	Save Parameters. If set, this bit instructs the drive to save all savable pages, and this is not supported on the tape drive.

4.9.1 Mode Parameter List

The following figure shows the format of the Mode Parameter List that is passed by the initiator to the tape drive during the command's DATA OUT phase.

Bit Byte	7	6	5	4	3	2	1	0
0 - 3	Mode Parameter Header							
4 - 11	Mode Parameter Block Descriptor (Optional)							
4 – 11 or 12 - n	Page(s) (Optional)							

Figure 4-38. MODE SELECT (6) Mode Parameter List — Data Format

Bit Byte	7	6	5	4	3	2	1	0
0 - 7	Mode Parameter Header							
8 - 15	Mode Parameter Block Descriptor (Optional)							
8 - n or 16 - n	Page(s) (Optional)							

Figure 4-39. MODE SELECT (10) Mode Parameter List — Data Format

Table 4-39. MODE SELECT Mode Parameter List — Field Descriptions

Field Name	Description
Mode Parameter Header	Four bytes in length for MODE SELECT (6) or eight bytes in length for MODE SELECT (10). Contains information about the remainder of the Parameter List and is always present.
Mode Parameter Block Descriptor	8 bytes in length, allows the initiator to set the drive's Logical Block Size and Density Code to be written from BOT.
Page(s)	The Page Code(s) of the pages that are a part of this MODE SELECT command.

Mode Parameter Header

The figure and table that follow provide an illustration and description of the fields that make up the MODE SELECT command's Mode Parameter header.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	Media Type							
2	Ignored	Buffered Mode			Speed (0h)			
3	Block Descriptor Length							

Figure 4-40. MODE SELECT (6) Mode Parameter Header — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0 - 1	Reserved							
2	Media Type							
3	Ignored	Buffered Mode			Speed (0h)			
4 - 5	Reserved							
6 - 7	Block Descriptor Length							

Figure 4-41. MODE SELECT (10) Mode Parameter Header — Data Format

Table 4-40. MODE SELECT Mode Parameter Header — Field Descriptions

Field Name	Description
Media Type	This field is ignored by the MODE SELECT command.
Buffered Mode	Default = 1. The drive implements immediate reporting on WRITE commands through its buffered mode. With Buffered Mode set to 1, the drive reports GOOD status on WRITE commands as soon as the data block has been transferred to the buffer. If this field = 0, then the drive does not report GOOD status on WRITE commands until the data blocks have been written to tape. When Buffered Mode is not used, the tape drive suffers significant performance and capacity degradation. If Buffered Mode is set to a number greater than 1, the command is rejected with CHECK CONDITION, sense key of ILLEGAL REQUEST.
Speed	The tape drive supports a single speed of operation per format. This field must be set to 0. Any other value will cause a CHECK CONDITION status with a sense key of ILLEGAL REQUEST to be returned.
Block Descriptor Length	This field specifies the length in bytes of all the block descriptors. Since the drive only allows one block description, the value must be either 0 or 8. A value of 0 indicates no block description is included; a value of 8 indicates a block descriptor is present and precedes the mode page data. Any value other than 0 or 8 causes a CHECK CONDITION status with sense key of ILLEGAL REQUEST to be returned.

Mode Parameter Block Descriptor

The figure and table that follow provide an illustration and description of the fields that make up the MODE SELECT command's Mode Parameter Block Descriptor.

Bit / Byte	7	6	5	4	3	2	1	0
0	Density Code							
1 - 3	(MSB) Number of Blocks (LSB)							
4	Reserved							
5 - 7	(MSB) Block Length (LSB)							

Figure 4-42. MODE SELECT Mode Parameter Block Descriptor — Data Format

Table 4-41. MODE SELECT Mode Parameter Block Descriptor — Field Descriptions

Field Name	Description	
Density Code	This field should contain one of the Density Code values listed below:	
	Density Code	**Description**
	00h	Use default density
	1Ah	81633 bpi, 64 track pairs, serial cartridge tape - 20.0 GB / 40.0 GB (DLT IV only)
	1Bh	85937 bpi, 52 quad pairs, serial cartridge tape - 35.0 GB / 70.0 GB (DLT IV only)
	40h	123090 bpi, 84 track pairs, serial cartridge tape - 40.0 GB / 80.0 GB (DLT IV)
	41h	98250 bpi, 52 quad pairs, serial cartridge tape - 40.0 GB / 80.0 GB (DLT IV)
	48h	133000 bpi, 56 logical tracks, serial cartridge tape - 110.0 GB / 220.0 GB (Super DLTtape I)

Table 4-41. MODE SELECT Mode Parameter Block Descriptor — Field Descriptions

Field Name	Description	
	49h	190000 bpi, 56 logical tracks, serial cartridge tape - 160.0 GB / 320.0 GB (Super DLTtape I)
	7Fh	No change from previous density (No Operation)
		The density codes listed above are the **preferred** codes used to define density. Additionally, the codes listed below may be used, even though use of the Data Compression Page is preferred.
	82h	81633 bpi, 64 track pairs, serial cartridge tape - 20.0 GB (DLT IV) without compression
	83h	81633 bpi, 64 track pairs, serial cartridge tape - 40.0 GB (DLT IV) with compression
	84h	85937 bpi, 52 quad tracks, serial cartridge tape - 35.0 GB (DLT IV) without compression
	85h	85937 bpi, 52 quad tracks, serial cartridge tape - 70.0 GB (DLT IV) with compression
	86h	123090 bpi, 84 track pairs, serial cartridge tape - 40.0 GB (DLT IV) without compression
	87h	123090 bpi, 84 track pairs, serial cartridge tape - 80.0 GB (DLT IV) with compression
	88h	98250 bpi, 52 quad tracks, serial cartridge tape - 40.0 GB (DLT IV) without compression
	89h	98250 bpi, 52 quad tracks, serial cartridge tape - 80.0 GB (DLT IV) with compression
	90h	133000 bpi, 56 logical tracks, serial cartridge tape - 110.0 GB (Super DLTtape I) without compression
	91h	133000 bpi, 56 logical tracks, serial cartridge tape - 220.0 GB (Super DLTtape I) with compression
	92h	190000 bpi, 56 logical tracks, serial cartridge tape, 160.0 GB (Super DLTtape I) without compression
	93h	190000 bpi, 56 logical tracks, serial cartridge tape, 320.0 GB (Super DLTtape I) with compression

Table 4-41. MODE SELECT Mode Parameter Block Descriptor — Field Descriptions

Field Name	Description
Number of Blocks	This field is must be set to 0 indicating that all of the remaining logical blocks on the tape will have the medium characteristics specified by this block descriptor.
Block Length	This field specifies the length, in bytes, of each logical block transferred over the SCSI bus. A block length of 0 indicates that the length is variable (specified in the I/O command). Any value other than 0 indicates the number of bytes per block to use for READ, WRITE, and VERIFY commands that specify a “fixed” bit of 1 (i.e., Fixed Block Mode) which also causes the transfer length in the Command Descriptor Block to be defined as a block count. If the fixed bit is not equal to 1, this field is ignored.

Mode Page Descriptors

Following the MODE SELECT command’s Mode Parameter Block Descriptor are the MODE SELECT pages, each of which sets a different device parameter. Each Mode page has a 2-byte header that identifies the page code and indicates the number of bytes in that page.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code					
1	Additional Page Length							
2 - *n*	Page-Defined or Vendor-Specific Parameter List							

Figure 4-43. MODE SELECT Page Descriptor — Data Format

Table 4-42. MODE SELECT Page Descriptor — Field Descriptions

Field Name	Description
PS	Parameters Savable. For the MODE SELECT (6) (10) commands, this field is reserved (0).
Additional Page Length	Indicates number of bytes in that page (not including bytes 0 and 1).
Page-Defined or Vendor Specific Parameter List	Information in this field depends on the mode page (for details, refer to a list of all supported mode pages on page 4-65).

4.9.2 Read / Write Error Recovery Page (01h)

The Read / Write Error Recovery Page controls the drive's response to error conditions that arise during the course of READ and WRITE command processing.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (01h)					
1	Additional Page Length (0Ah)							
2	Rsv'd	Rsv'd	TB	Rsv'd	EER (1)	PER	DTE (0)	DCR (0)
3	Read Retry Count							
4 – 7	Reserved							
8	Write Retry Count							
9 – 11	Reserved							

Figure 4-44. Read / Write Error Recovery Page — Data Format

Table 4-43. Read / Write Error Recovery Page — Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Additional Page Length	This field indicates the number bytes in the page. However, the value does not include bytes 0 and 1. The length is returned in MODE SENSE commands and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The drive returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receives an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.
TB	Transfer Block. Not supported.
EER	Enable Early Recovery. Set to 1 (always enabled).
PER	Post Error. Default is 0. When set to 1, this bit enables reporting of Check Condition to report recovered READ / WRITE errors.
DTE	Disable Transfer on Error. Not supported; must be 0.
DCR	Disable ECC Correction. Not supported; must be 0.
Read Retry Count	This field reports the maximum number or rereads that are attempted before declaring an unrecoverable error.
Write Retry Count	This field reports the maximum number of overwrite retries that will be attempted before declaring an unrecoverable error.

4.9.3 Disconnect / Reconnect Page (02h)

The Disconnect / Reconnect Page controls the drive's behavior on the SCSI bus and allows an initiator to tune bus performance.

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (02h)					
1	Additional Page Length (0Eh)							
2	Buffer Full Ratio							
3	Buffer Empty Ratio							
4 - 5	(MSB) Bus Inactivity Limit (LSB)							
6 - 7	(MSB) Disconnect Time Limit (LSB)							
8 - 9	(MSB) Connect Time Limit (LSB)							
10 - 11	(MSB) Maximum Burst Time (LSB)							
12	Reserved							DTDC
13 - 15	Reserved							

Figure 4-45. Disconnect / Reconnect Page — Data Format

Table 4-44. Disconnect / Reconnect Page — Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Additional Page Length	This field indicates the number of bytes in the page. However, the value does not include bytes 0 and 1. The length is returned in MODE SENSE commands and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The drive returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receives an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.
Buffer Full Ratio	Not supported. Any value is ignored.
Buffer Empty Ratio	Not supported. Any value is ignored.
Bus Inactivity Limit	Not supported. Any value is ignored.
Disconnect Time Limit	Not supported. Any value is ignored.
Connect Time Limit	Not supported. Any value is ignored.
Maximum Burst Size	This value specifies the maximum amount of data that will be transferred without disconnecting. A value of 0 sets no limit. Any value is in units of 512 bytes. For example, a value of 8 represents 4 Kbytes. Values that are not multiples of 8 are rounded up to the closest multiple of 8.
DTDC	Data Transfer Disconnect Control. This field defines further restrictions for when disconnect is permitted. **DTDC** — **Description** 00b — Data transfer disconnect control is not used. Disconnect is controlled by the other fields in this page. 01b — Once the data transfer of a command has been started, a target does not attempt to disconnect until all the data to be transferred has been transferred. 10b — Reserved.

Table 4-44. Disconnect / Reconnect Page — Field Descriptions (Continued)

Field Name	Description
	11b Once the data transfer of a command has started, a target does not attempt to disconnect until the command is complete. If DTDC is a non-zero value and the maximum burst size is non-zero, the tape drive returns to CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code to ILLEGAL FIELD IN PARAMETER LIST.

4.9.4 Control Mode Page (0Ah)

The Control Mode Page provides control over several features such as tagged queuing, extended contingent allegiance, asynchronous event notification, and error logging.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsv'd	Page Code (0Ah)					
1	Page Length (06)							
2	Reserved							RLEC
3	Queue Algorithm Modifier (0)				Reserved		QErr (0)	DQue (0)
4	EECA (0)	Reserved				RAENP (0)	UAAENP (0)	EAENP (0)
5	Reserved							
6 - 7	(MSB) Ready AEN Holdoff Period (0) (LSB)							

Figure 4-46. Control Mode Page Format Descriptor — Data Format

Table 4-45. Control Mode Page Descriptor — Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Page Length	The Page Length field indicates the number of bytes in the Control Mode Page that follow this byte. The valid value for this byte is 06h.
RLEC	Report Log Exception Condition. When set to 1, specifies that the target will report log exception conditions. When 0, specifies that the target will not report log exception conditions. The RLEC bit works in conjunction with the Read / Write Error LOG SENSE Page, specifically, the TMC bit of the Read / Write Error LOG SENSE Page (Page 02h and 03h), described in Table 4-22 on page 4-47. The RLEC bit indicates whether the drive should return CHECK CONDITION status with sense key set to UNIT ATTENTION when one of the READ and WRITE error counters of the log pages reach a specified threshold. Thresholds can be modified using LOG SELECT.
Queue Algorithm Modifier	Queue Algorithm Modifier. Must be 0.
QErr	Queue Error. Must be 0.
DQue	Disable Queuing. Must be 0.
EECA	Enable Extended Contingent Allegiance. Not supported; must be 0.
RAENP	Ready Asynchronous Event Notification. Not supported; must be 0.
UAAENP	Unit Attention Asynchronous Event Notification. Not supported; must be 0.
EAENP	Enable Asynchronous Event Notification Permission. Not supported, must be 0.
Ready AEN Holdoff Period	Not supported; must be 0.

4.9.5 Data Compression Page (0Fh)

The Data Compression page specifies parameters for the control of data compression. This page allows the user to turn the tape drive's compressed format on and off independently of the tape medium's position.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (0Fh)					
1	Page Length (0Eh)							
2	DCE	DCC(1)	Reserved					
3	DDE (1)	RED(0)	Reserved					
4 - 7	(MSB) Compression Algorithm (10h) (LSB)							
8 - 11	(MSB) Decompression Algorithm (10h) (LSB)							
12 - 15	Reserved							

Figure 4-47. Data Compression Page Format Descriptor — Data Format

Table 4-46. Data Compression Page Descriptor — Field Descriptions

Field Name	Description
Page Code	The Page Code field identifies the type of MODE SELECT page being transferred. A value of 0Fh identifies this as the Data Compression page.
Page Length	The Page Length field indicates the number of bytes in the Data Compression page that follow this byte. The valid value for this byte is 0Eh.
DCE	Data Compression Enable. This bit specifies whether the tape drive should enable or disable data compression. When set to 1, the drive compresses all data before writing it to tape.
DCC	Data Compression Capable. This bit is used by the MODE SENSE command to indicate that the tape drive supports data compression.
DDE	Data Decompression Enable. Must be set to 1. When the tape drive reads compressed data from tape, it automatically decompresses the data before sending it to the initiator. Data decompression must always be enabled.
RED	Report Exception on Decompression. The tape drive does not report exceptions on decompression (boundaries between compressed and uncompressed data). The RED field must be 00h.
Compression Algorithm	The Compression Algorithm field indicates which compression algorithm the tape drive will use to process data from the initiator when the DCE bit (byte 02, bit 7) is set to 1. The only value currently supported for this field is 10h. Specifying a value other than 10h for this field causes the tape drive to return CHECK CONDITION status, sense key set to ILLEGAL REQUEST. However, if EEPROM parameter EnaRepDecomp is set, the parameter in this field is ignored and no CHECK CONDITION status is returned.
Decompression Algorithm	The Decompression Algorithm field indicates which decompression algorithm the tape drive will use when decompressing data on the tape. The only value currently supported is 10h. Specifying a value other than 10h for this field causes the tape drive to return CHECK CONDITION status, sense key set to ILLEGAL REQUEST.

4.9.6 Device Configuration Page (10h)

The Device Configuration Page controls the drive's behavior on the SCSI bus and allows an initiator to tune bus performance

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (10h)					
1	Additional Page Length (0Eh)							
2	Rsv'd	CAP (0)	CAF (0)	Active Format (0)				
3	Active Partition (0)							
4	Write Buffer Full Ratio							
5	Read Buffer Empty Ratio							
6 - 7	(MSB) Write Delay Time (LSB)							
8	DBR (0)	BIS	RSmk (0)	AVC (0)	SOCF (0)		RBO (0)	REW (0)
9	Gap Size (0)							
10	EOD Defined (0)			EEG	SEW	Reserved		
11 - 13	(MSB) Buffer Size at Early Warning (0) (LSB)							
14	Select Data Compression Algorithm							
15	Reserved							

Figure 4-48. Device Configuration Page — Data Format

Table 4-47. Device Configuration Page — Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Additional Page Length	This field indicates the number bytes in the page. However, the value does not include bytes 0 and 1. The length is returned in MODE SENSE commands and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The drive returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receives an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.
CAP	Change Active Partition. Not supported; must be 0.
CAF	Change Active Format. Not supported; must be 0.
Active Format	Active Format. Not supported; must be 0.
Active Partition	Active Partition. Only partition 0 is supported. Setting this field to any other value causes rejection by the drive with a CHECK CONDITION status, sense key ILLEGAL REQUEST set.
Write Buffer Full Ratio	The drive sets this field to 0. The drive uses an automatic adaptive mechanism to adjust its Write Buffer Full Ratio according to the average data rates over the SCSI bus.
Read Buffer Empty Ratio	The drive sets this field to 0. The drive uses an automatic adaptive mechanism to adjust its Read Buffer Empty Ratio according to the average data rates over the SCSI bus.
Write Delay Time	This field indicates the maximum time that the drive will wait with a partially full buffer before forcing the data to tape (100 ms increments). The buffer Full/Empty ratio, which is dynamic, can cause data to be written sooner than the Write Delay Time would indicate. The Write Delay Time defaults to 100 (64h). This causes the buffer to be flushed in 10 seconds. Maximum value is 6500 (1964h) and the minimum is 15 (0Fh). This represents a range from 11 minutes down to 1.5 seconds. A value of 0 disables forcing data to tape based on time in the buffer. Values greater than 6500 are rounded down to 6500.
DBR	Data Buffer Recovery. Not supported; must be 0.
BIS	Block Identifiers Supported. This field is supported. Set to 1.
RSmk	Report Setmark. Not supported, must be 0.
AVC	Automatic Velocity Control. Not supported; must be 0.

Table 4-47. Device Configuration Page — Field Descriptions (Continued)

Field Name	Description
SOCF	Stop on Consecutive Filemarks. Not supported; must be 0.
RBO	Recover Buffer Order. Not supported; must be 0.
REW	Report Early Warning. Not supported; must be 0 (do not report Early Warning EOM on READ).
Gap Size	Not used; must be 0.
EOD Defined	End-of-Data Defined. This field must be set to 00h.
EEG	Enable End-of-Data Generation. This field indicates that the drive will generate an EOD. The drive generates an EOD mark before any change of direction following a WRITE-type operation. This bit must be 1.
SEW	Synchronize at Early Warning. When set to 1, any unwritten data or tapemarks are written to the medium before each command completes once the End of Medium early warning point is reached, effectively operating as if in unbuffered mode. When set to 0, the drive continues to operate in buffered mode, if enabled, past the End of Medium early warning point. The default value is 1.
Buffer Size at Early Warning	Not supported; must be 0.
Select Data Compression Algorithm	When set to 1, enables data compression. When 0, disables data compression.

4.9.7 Medium Partition Page (11h)

The drive supports the Medium Partition Parameters Page that is used to specify the medium partitions.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (11h)					
1	Additional Page Length (06)							
2	Maximum Additional Partitions (0)							
3	Additional Partitions Defined (0)							
4	FDP (0)	SDP (0)	IDP (0)	PSUM (0)	Reserved			
5	Medium Format Recognition (01)							
6 - 7	Reserved							

Figure 4-49. Medium Partition Page Format Descriptor — Data Format

Table 4-48. Medium Partition Page Descriptor — Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Additional Page Length	This field indicates the number bytes in the page. However, the value does not include bytes 0 and 1. The length is returned in MODE SENSE commands and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The drive returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receives an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.
Maximum Additional Partitions	Not supported. Must be 0.
Additional Partitions Defined	Must be 0. This field specifies the number of additional partitions to be defined for the tape based on the settings of the SDP and IDP bits. The maximum allowed is the value returned in the Maximum Additional Partitions field. Only one partition is supported, therefore the value of the field must be 0.

Table 4-48. Medium Partition Page Descriptor — Field Descriptions (Continued)

FDP	Fixed Data Partitions. Must be 0.
SDP	Select Data Partitions. Must be 0.
IDP	Initiator Defined Partitions. Must be 0.
PSUM	Partition Size Unit of Measure. Must be 0.
Medium Format Recognition	This field is valid for MODE SENSE only, and is set to 01h, indicating that Medium Format Recognition is supported.

4.9.8 TapeAlert Page (1Ch)

The drive supports the TapeAlert Page that is used to set/change the supported TapeAlert configuration options (use the MODE SENSE command to read the settings of the TapeAlert page).

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (1Ch)					
1	Additional Page Length (0A)							
2	Perf	Reserved			DExcpt	Test	Rsv'd	LogErr
3	Reserved				MRIE			
4 – 7	(MSB) Interval Timer (LSB)							
8 – 11	(MSB) Report Count / Test Flag Number (LSB)							

Figure 4-50. TapeAlert Page Format Descriptor — Data Format

Table 4-49. TapeAlert Page Format Descriptor — Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Additional Page Length	This field indicates the number bytes in the page. However, the value does not include bytes 0 and 1. The length is returned in MODE SENSE commands and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The drive returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receives an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.
Perf	Performance bit. Performance Impacting Exceptions are acceptable. This bit is ignored.
DExcpt	Disable Information Exception Operations. If set to 0, the reporting method specified by the contents of MRIE is selected. When this bit is set to 1, all information exception conditions are disabled regardless of the contents for the MRIE field. When in this mode, the TapeAlert Log page is polled by the software. To enable CHECK CONDITION mode, DExcpt should set to 0. Default setting is 1.
Test	Test Bit. Used to generate false TapeAlert conditions to test the response to failure conditions. See the Report Count / Test Flag Number description for more information. If both Test and DExcpt are set to one, the drive will return CHECK CONDITION status, with a sense key ILLEGAL REQUEST, and additional sense data of INVALID FIELD IN PARAMETER LIST.
LogErr	Error Log. Not supported, must be 0.
MRIE	Method for Reporting Informational Exceptions. The tape drive uses the contents of this field to report information about exception conditions. Three methods are available: **Value Method** 00h No reporting of Informational Exception Conditions. The device server does not report information exception conditions. 03h Conditionally Generate Recovered Error. The device server reports informational exception conditions, if such reports of recovered errors are allowed, by returning CHECK CONDITION status on the next SCSI command (except INQUIRY and REQUEST SENSE commands) following detection of the condition. The sense key is set to RECOVERED ERROR with an additional sense code of 5Dh/ 00h (TapeAlert Event). The SCSI command with the CHECK CONDITION status completes without error prior to the report of any exception condition, and does not need to be repeated.

Table 4-49. TapeAlert Page Format Descriptor — Field Descriptions (Continued)

Field Name	Description
MRIE (cont.)	**Value** **Method** (cont.) 04h Unconditionally Generate Recovered Error. The drive reports informational exception conditions by returning CHECK CONDITION status on the next SCSI command (except INQUIRY and REQUEST SENSE commands) following detection of the condition. The sense key is set to RECOVERED ERROR with an additional sense code of 5D 00 (TapeAlert Event). The SCSI command with CHECK CONDITION completes without error prior to the report of any exception condition, and does not need to be repeated. 06h Only Report Informational Exception Condition on Request. The device server preserves information exception data. To access the data, a poll can be taken by issuing an unsolicited REQUEST SENSE command. The sense key is set to NO SENSE with an additional sense code of 5D 00 (TapeAlert Event). The additional sense code of 5D 00 for values 03h, 04h, and 06h signals that a TapeAlert event has occurred. Information about the event is stored in the TapeAlert Log Page. The setting of MRIE does not impact logging of events in the TapeAlert Log Page.
Interval Timer	Not supported, must be 0.
Report Count / Test Flag Number	Report Count or Test Flag Number. This field must be set to 0 unless the Test bit is set. When the Test bit is set, this field indicates that a test condition to be generated as follows: **Value** **Result** 0 Change no TapeAlert Flag but report an exception condition based on the setting of the MRIE field. 1 to 64 Set the TapeAlert flag indicated in the value and generate an exception condition based on the MRIE field. -1 to -64 Clear the TapeAlert flag in an equivalent manner to taking corrective action for the flag indicated by the absolute number of the value. 32767 Set all TapeAlert flags and generate and exception condition based on the setting of the MRIE field.

4.9.9 Vendor Specific Configuration Page (25h)

The drive supports a Vendor Specific Configuration Page that is used to set/change the vendor-unique configuration features. Currently, the only feature supported is the Default Density Override feature. Figure 4-51 shows the page that can be changed via the MODE SELECT command, and subsequently queried by the MODE SENSE command.

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (25h)					
1	Additional Page Length (08)							
2	Default Density Override (0, 48h, 49h)							
3	Reserved							RWCB
4 – 9	Reserved							

Figure 4-51. Vendor Specific Configuration Page Format Descriptor — Data Format

Table 4-50. Vendor Specific Configuration Page Format Descriptor — Field Descriptions

Field Name	Description
Default Density Override	The following density codes are the **preferred** codes used to define density. **Code** **Description** 00h Density override disabled. 48h 133000 bpi, 56 logical tracks, serial cartridge tape - 110.0 GB / 220.0 GB (Super DLTtape I) 49h 190000 bpi, 56 logical tracks, serial cartridge tape - 160.0 GB / 320.0 GB (Super DLTtape I) This one-byte field holds the setting of the density desired on a write from BOT. It can be set at any time, but will zeroed out during a cartridge load. Therefore, for the override to be meaningful, it must be set after the cartridge is loaded. After being set, its value will override any application resetting the drive to default density (0) via a MODE SELECT command.
RWCB	Rewrite Calibration tracks on any WRITE from BOT or WRITE FILEMARK from BOT with 1 or more filemarks specified in the WRITE FILEMARK CDB. This feature can be used to reinitialize the calibration tracks. The recommended implementation is to utilize the WRITE FILEMARK command with 2 filemarks specified in the WRITE FILEMARK CDB, after setting the RWCB bit. This is because a tape with 2 filemarks at BOT is widely recognized by software applications to indicate the tape is blank. **Important**: This function adds 10–18 minutes to the initial WRITE / WRITE FILEMARKS from BOT, because calibration tracks are located at both ends of the tape.

4.9.10 Disaster Recovery Control Page (3Ch)

This page controls the operation of the Disaster Recovery Control Mode for the drive.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS(0)	Rsv'd	Page Code (3Ch)					
1	Page Length (4)							
2	Reserved							DRAct
3 - 5	Reserved							

Figure 4-52. Disaster Recovery Control Page — Data Format

Table 4-51. Disaster Recovery Control Page — Field Description

Field Name	Description
DRAct	Disaster Recovery Active. Set this bit to 0 to disable Disaster Recovery mode.

4.9.11 EEPROM Vendor Specific Page (3Eh)

The drive supports a Vendor Specific page that enables a user to modify savable parameters. Only one savable parameter may be changed per MODE SELECT command.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS	Rsv'd	Page Code (3Eh)					
1	Additional Page Length							
2	ASCII String of Parameter Name and Value							

Figure 4-53. EEPROM Vendor Specific Page — Data Format

The ASCII string has a parameter name, followed by one or more space characters, a parameter value, and an ASCII line feed or null character. When the string is

parsed, the parameter value is interpreted as shown in the following table. Note that the parameter name may be in upper or lower case. The savable parameters are saved during resets and power cycles.

Table 4-52. EEPROM Vendor Specific Page — Parameters

Parameter Name	Value Rep.	Default	Length (Bytes)	Usage
VendorID	ASCII	QUANTUM	8	Vendor Identification field in INQUIRY data.
ProductID	ASCII	SuperDLT1 / SDLT 320	16	Product Identification field in INQUIRY data. (SuperDLT1 for 220 tape drive / SDLT 320 for 320 tape drive.)
BTHDirMode	ASCII Decimal	2	1	Obsolete.
CacheTMs	ASCII Binary	0	1	When set, a WRITE FILEMARKS command that writes a single filemark and is not preceded by another WRITE FILEMARKS command will always be treated as if the Immed bit was set to 1.
DefaultCompON	ASCII Binary	1	1	0 = Compression defaulted OFF at power-on/reset. 1 = Compression defaulted ON at power-on/reset.
DefFixedBlkLen	ASCII Decimal	0	4	Default fixed block size.
DefSEW	ASCII Binary	1	1	To set default SEW (Synchronize at Early Warning) parameter.
DisDeferClnRpt	ASCII Binary	0	1	When set, a cleaning report is sent over the library port as soon as the cleaning light illuminates. If not set, then the report is sent only at unload.
DisUnbufMode	ASCII Binary	0	1	When set, the drive completely disables unbuffered mode; in other words, it ignores the MODE SELECT “buffered mode” selection to turn off buffered mode. If not set, “buffered mode” can be enabled or disabled.
EnaCleanLib	ASCII Binary	1	1	When set, cleaning status is reported via the library tape drive interface. If not set, this functionality is disabled.

Table 4-52. EEPROM Vendor Specific Page — Parameters (Continued)

Parameter Name	Value Rep.	Default	Length (Bytes)	Usage
EnaCleanLight	ASCII Binary	1	1	When set, the Cleaning Required LED is turned on and off as appropriate. If not set, this functionality is disabled.
EnaCleanSense	ASCII Binary	1	1	When set, cleaning sense key data is collected. If not set, this functionality is disabled.
EnaCleanTA	ASCII Binary	1	1	When set, tape cleaning flags for TapeAlert are returned. If not set, this functionality is disabled.
EnaGranularity	ASCII Binary	1	1	Enables granularity field in READ BLOCK LIMITS command.
EnaInitSyncNeg	ASCII Binary	0	1	When set, enables target-initiated synchronous negotiation.
EnaModePg22	ASCII Binary	0	1	To enable vendor-specific data compression (Status Mode Page).
EnaModePg3C	ASCII Binary	1	1	To enable Disaster Recovery Mode (Page 3C).
EnaReadPosLong	ASCII Binary	1	1	To enable Long Data Format in READ POSITION command.
EnaRepDecomp	ASCII Binary	0	1	If set and if the drive is in READ mode, the decompression algorithm field in Data Compression mode will be reset if the last block requested by the host was decompressed, otherwise it is cleared.
EnaReqAckActNeg	ASCII Binary	1	1	Enables active negation on REQ and ACK signals.
EnaSCSIFilter	ASCII Binary	1	1	Enables SCSI filter on the SCSI chip.
EnaSCSIUnlonPMR	ASCII Binary	0	1	When set, enables a SCSI Unload when a previous PREVENT MEDIUM REMOVAL command is in effect.
EnaSoftClean	ASCII Binary	0	1	When set, periodic cleaning (of the heads) is enabled. If not set, this functionality is disabled.

Table 4-52. EEPROM Vendor Specific Page — Parameters (Continued)

Parameter Name	Value Rep.	Default	Length (Bytes)	Usage
EnaThirdPtyDens	ASCII Binary	1	1	When set, make non-DLT density codes act as the default density (same as density code 0).
ForceComp	ASCII Binary	0	1	0 = Automatic‡ 1 = Force Compression disabled 2 = Force compression enabled
ForceDensity*	ASCII Decimal	0	1	0 = Automatic‡ 1 = DLT 4000 2 = DLT 7000 3 = DLT 8000 4 = SuperDLT1 5 = Benchmark DLT1 6 = SDLT 320
ForceEERebuild	ASCII Binary	0	1	When set, forces the parameters to all be reset to default values at the next power cycle.
MaxBurstSize	ASCII Binary	0080h	2	The value in this field specifies the maximum amount of data to be transferred without disconnecting. A value of 0 sets no limit. This value is given in 512 byte increments. For example, a value of 8 indicates 4K bytes. Values that are not multiples of 8 are rounded down to the nearest multiple of 8. Minimum value of this field is 0000h, maximum is FFFFh.
NoDeferRcvdErr	ASCII Binary	0	1	When set, the drive reports deferred recovered error as current recovered error.
NoSCSIEject	ASCII Binary	0	1	Disable ejection of the cartridge at the completion of an unload operation initiated by a SCSI LOAD UNLOAD command.
RedundancyMode	ASCII Decimal	1	1	Sets the value of the allowed maximum marginal channel (0 - 7 allowed).

Table 4-52. EEPROM Vendor Specific Page — Parameters (Continued)

Parameter Name	Value Rep.	Default	Length (Bytes)	Usage
RepBusyInProg	ASCII Binary	0	1	When set, report BUSY status if the drive is in the process of becoming ready.
ReportRcvdPerrs	ASCII Binary	1	1	When set, report recovered error (if parity error has been retried successfully).
ReportRcvdRdErr	ASCII Binary	0	1	This parameter sets the default value of PER bit of READ / WRITE Error Recovery Mode page (01h).
RepUaOnSeqUnld	ASCII Binary	0	1	Obsolete.
RewindOnReset	ASCII Binary	1	1	When set, rewind the tape medium to BOT on reset. When not set, do *not* rewind on BUS RESET or BDR message. (CAUTION: May have partial block data written to tape if reset occurs during WRITE.)
SCSI3Inq	ASCII Binary	0	1	When set, data returned to the SCSI INQUIRY command complies with the SPC-2 specification. When not set, the data returned complies with X3.131-1994 (SCSI-2).
SCSI3Sense	ASCII Binary	1	1	Enable reporting of ASC/ASCQ values unique to SCSI-3.
SCSIBusDMATimer	ASCII Decimal	2	1	The number of seconds until the drive times out waiting for ACK once DMA transfer started. When set to 0, the timer is set to infinite.
SCSIReselRetries	ASCII Decimal	10	1	The number of reselection retries the drive makes before giving up. Each reselection retry occurs every 1 second. When set to 0, the drive never gives up (it performs infinite reselection retries).
SCSIResRelNOP	ASCII Binary	0	1	SCSI RESERVE / RELEASE UNIT commands are no operation (if set).

Table 4-52. EEPROM Vendor Specific Page — Parameters (Continued)

Parameter Name	Value Rep.	Default	Length (Bytes)	Usage
SCSIXferMax	ASCII Decimal	0	1	0 = Best possible speed. 5 = Limit to 5 MB/sec. 10 = Limit to 10 MB/sec. 20 = Limit to 20 MB/sec. 40 = Limit to 40 MB/sec.
SetEOMatBOM	ASCII Binary	0	1	When set, sets EOM field in byte 2 of REQUEST SENSE data when encountering BOM.
SetEOMatEW	ASCII Binary	0	1	When set, sets EOM field in byte 2 of REQUEST SENSE data when encountering Early Warning End Of Media (for all operations).
TaMrieDefault	ASCII Decimal	3	1	Default setting for the MRIE field in the TapeAlert Mode Page.
ThirdPartyDen	ASCII Decimal	0	1	Value of default third party density. Requires EnaThirdPartyDens = 1

* Parameter is not forced to a special format. Instead, it is determined by the parameters selected via MODE SELECT.

‡ Applied to DLT IV format tape for DLT 4000, DLT 7000, and DLT 8000 tape drive.

The following is a sample of an EEPROM vendor specific page that modifies the VendorID parameter to “XXXYY.”

0	**0**	**0**	**Page Code (3Eh)**
1	Page Length (0Fh)		
2	“v” (76h)		
3	“e” (65h)		
4	“n” (6Eh)		
5	“d” (64h)		
6	“o” (6Fh)		
7	“r” (72h)		
8	“i” (69h)		
9	“d” (64h)		
10	“ ” (20h)		
11	“X” (58h)		
12	“X” (58h)		
13	“X” (58h)		
14	“Y” (59h)		
15	“Y” (59h)		
16	(A0h) or (00h)		

Figure 4-54. EEPROM Vendor Specific Page “Vendor ID” Sample — Data Format

The following is a sample of an EEPROM vendor specific page that modifies the ForceDensity parameter to “4.”

0	**0**	**0**	**Page Code (3Eh)**
1	Page Length (0Fh)		
2	“F” (46h)		
3	“O” (4Fh)		
4	“R” (52h)		
5	“C” (43h)		
6	“E” (45h)		
7	“D” (44h)		
8	“E” (45h)		
9	“N” (4Eh)		
10	“S” (53h)		
11	“I” (49h)		
12	“T” (54h)		
13	“Y” (59h)		
14	“ ” (20h)		
15	“4” (ASCII) (34h)		
16	(A0h) or (00h)		

Figure 4-55. EEPROM Vendor Specific Page “Forced Density” Example — Data Format

4.9.12 Changeable Parameters Within MODE SELECT

The following table lists the MODE SELECT command's changeable parameters and their default, minimum, and maximum values. Descriptions of the various parameters are provided in the discussions of the different mode pages within MODE SELECT.

NOTE: Parameter rounding is supported for all parameters except for the block descriptor length.

Table 4-53. Changeable Mode Parameters Within MODE SELECT

Page: Parameter	Default	Minimum	Maximum
Header: Buffered Mode, Device Specific Byte	1	0	1
Block Descriptor Length	08h	00h	08h
Block Descriptor: Block Length			
20.0 GB and 40.0 GB Mode	0	0	FFFFFEh
35.0 GB and 70.0 GB Mode	0	0	FFFFFEh
40.0 GB and 80.0 GB Mode	0	0	FFFFFEh
110.0 GB and 220.0 GB Mode	0	0	FFFFFCh
160.0 GB and 320.0 GB Mode	0	0	FFFFFCh
READ / WRITE Error Recovery (01h): PER bit	0	0	1
Control Mode (0Ah): Report Log Exception Condition	0	0	1
Data Compression (0Fh): Data Compression Enable	1	0	1
Disconnect / Reconnect (02h): Maximum Burst Size	0080h	0000h	FFFFh
Disconnect / Reconnect (02h): DTDC	0	0	3
Device Configuration (10h): Write Delay Time	C8h	0Fh	64h
Device Configuration (10h): Synchronize at Early Warning	1	0	1
Device Configuration (10h): Select Data Compression Algorithm	1	0	1

4.10 MODE SENSE (6) / (10) Command (1Ah/ 5Ah)

The MODE SENSE command allows the drive to report its media type, and current, or changeable configuration parameters to the host. It is a complementary command to MODE SELECT.

The Command Descriptor Block for the 6-byte MODE SENSE (1Ah) command is shown below. An illustration of the Command Descriptor Block for the 10-byte MODE SENSE (5Ah) command follows on the next page.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ah)							
1	Logical Unit Number			Rsv'd	DBD	Reserved		
2	PC		Page Code					
3	Reserved							
4	Allocation Length							
5	Unused		Reserved				Flag	Link

Figure 4-56. MODE SENSE (6) Command Descriptor Block — Data Format

The 10-byte MODE SENSE command is required to request the vendor-specific EEPROM parameter page due to the large amount of data that parameter page contains. MODE SENSE (10) can be used to retrieve the other pages as well. Note that MODE SENSE (10) returns descriptor data in a different format than MODE SENSE (6).

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (5Ah)							
1	Logical Unit Number			Rsv'd	DBD	Reserved		
2	PC		Page Code					
3 - 6	Reserved							
7 - 8	(MSB) Allocation Length (LSB)							
9	Unused		Reserved				Flag	Link

Figure 4-57. MODE SENSE (10) Command Descriptor Block — Data Format

Table 4-54. MODE SENSE Command Descriptor Block — Field Descriptions

Field Name	Description
DBD	Disable Block Descriptors. If 0, device returns the block descriptor data. If set to 1, block descriptor information is not returned.
PC	Page Control. The Page Control field indicates the type of page parameter values to be returned to the host: **PC** — **Type of Parameter Values** 00 — Report Current Values 01 — Report Changeable Values 10 — Report Default Values 11 — Report Saved Values
Page Code	This field allows the host to select any specific page or all of the pages supported by the drive.
Allocation Length	This field specifies the number of bytes that the host has allocated for returned MODE SENSE data. An Allocation Length of zero indicates that the drive will return no MODE SENSE data. This is not considered an error, and GOOD status is returned.

MODE SENSE may be either MODE SENSE (6) or MODE SENSE (10). MODE SENSE (6) data contains a 4-byte header followed by one 8-byte block descriptor, followed by zero or more variable length pages, depending on the Page Code and Allocation Length.

4.10.1 MODE SENSE Data Headers

The MODE SENSE (6) and MODE SENSE (10) headers are depicted in the following figures.

Bit / Byte	7	6	5	4	3	2	1	0
0	Mode Sense Data Length							
1	Media Type							
2	WP	Buffered Mode			Speed (0)			
3	Block Descriptor Length							

Figure 4-58. MODE SENSE (6) Data Header — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0 - 1	(MSB) Mode Sense Data Length (LSB)							
2	Media Type							
3	WP	Buffered Mode			Speed (0)			
4 - 5	Reserved							
6 - 7	(MSB) Block Descriptor Length (LSB)							

Figure 4-59. MODE SENSE (10) Data Header — Data Format

Table 4-55. MODE SENSE Data Header — Field Descriptions

Field Name	Description
Mode Sense Data Length	This field specifies the length (in bytes) of the MODE SENSE data that is available to be transferred during the DATA IN phase. Note that the Mode Sense Data Length does not include itself.
Media Type	The media type is determined by the drive and can be one of the following: **Type** — **Description** 00h — Unknown or not present 81h — Cleaning tape 85h — DLT IV* 86h — Super DLTtape I
WP	Write Protect. If the field is 0, it indicates that the tape is write-enabled. If set to 1, it indicates that the tape is write-protected.
Buffered Mode	If the field is 0, then the drive does not report a GOOD status on WRITE commands until the data blocks are actually written to tape. If the field is 1, then the drive reports GOOD status on WRITE commands as soon as the data block has been transferred to the buffer. This is the default configuration of the drive. Note that if Buffered Mode is not used, the tape drive will suffer a degradation of performance and capacity.
Speed	This field is 0, indicating the default speed.
Block Descriptor Length	This field specifies the length (in bytes) of all of the block descriptors. If the DBD bit in the CDB is set to 0, this value will be 8 indicating one Block Descriptor was sent. If the DBD bit in the CDB is set to 1, this value will be 0, indicating no Block Descriptors were sent.

* When a DLT IV cartridge is mounted in the drive, the MODE SENSE information will report the Media Type as 85h and the correct Density Code as detected on the tape. Additionally, the Write Protect (WP) bit in the MODE SENSE header will be set. Any command that attempts to write to the medium (WRITE, WRITE FILEMARKS, ERASE) will return Check Condition status. The sense key will be set to Data Protect (7) and the ASC/ASCQ will be set to "Cannot Write Medium - Incompatible Format" (30h/05h). No update of the medium will be performed.

4.10.2 MODE SENSE Block Descriptor

The following figure describes the MODE SENSE block descriptor that follows the MODE SENSE header. Descriptions of the MODE SENSE block descriptor is provided in Table 4-56.

Bit Byte	7	6	5	4	3	2	1	0
0	Density Code							
1 - 3	(MSB) Number of Blocks (000000h) (LSB)							
4	Reserved							
5 - 7	(MSB) Block Length (LSB)							

Figure 4-60. MODE SENSE Block Descriptor — Data Format

Table 4-56. MODE SENSE Block Descriptor — Field Descriptions

Field Name	Description
Density Code	This field should match the current tape medium density; it is set to 0 if the density is unknown.

Code	Description
00h	Density unknown.
1Ah	81633 bpi, 64 track pairs, serial cartridge tape - 20.0 GB / 40.0 GB (DLT IV)
1Bh	85937 bpi, 52 quad pairs, serial cartridge tape - 35.0 GB / 70.0 GB (DLT IV)
40h	123090 bpi, 84 tracks pairs, serial cartridge tape - 40.0 GB / 80.0 GB (DLT IV)
41h	98250 bpi, 52 quad pairs, serial cartridge tape - 40.0 GB / 80.0 GB (DLT IV)
48h	133000 bpi, 56 logical tracks, serial cartridge tape - 110.0 GB / 220.0 GB (Super DLTtape I)
49h	190000 bpi, 56 logical tracks, serial cartridge tape - 160.0 GB / 320.0 GB (Super DLTtape I)

Table 4-56. MODE SENSE Block Descriptor — Field Descriptions (Continued)

Density Code (Cont.)	The following codes may be used once a MODE SELECT command using one of these codes has been received:

Code	Description
82h	81633 bpi, 64 track pairs, serial cartridge tape - 20.0 GB (DLT IV) without compression
83h	81633 bpi, 64 track pairs, serial cartridge tape - 40.0 GB (DLT IV) with compression
84h	85937 bpi, 52 quad tracks, serial cartridge tape - 35.0 GB (DLT IV) without ompression
85h	85937 bpi, 52 quad tracks, serial cartridge tape - 70.0 GB (DLT IV) with compression
86h	123090 bpi, 84 track pairs, serial cartridge tape - 40.0 GB (DLT IV) without compression
87h	123090 bpi, 84 track pairs, serial cartridge tape - 80.0 GB (DLT IV) with compression
88h	98250 bpi, 52 quad tracks, serial cartridge tape - 40.0 GB (DLT IV) without compression
89h	98250 bpi, 52 quad tracks, serial cartridge tape - 80.0 GB (DLT IV) with compression
90h	133000 bpi, 56 logical tracks, serial cartridge tape - 110.0 GB (Super DLTtape I) without compression
91h	133000 bpi, 56 logical tracks, serial cartridge tape - 220.0 GB (Super DLTtape I) with compression
92h	190000 bpi, 56 logical tracks, serial cartridge tape - 160.0 GB (Super DLTtape I) without compression
93h	190000 bpi, 56 logical tracks, serial cartridge tape - 320.0 GB (Super DLTtape I) with compression

Number of Blocks	This field is sent as 0, indicating that all of the remaining logical blocks on the tape have the medium characteristics specified by the block descriptor.
Block Length	This field specifies the length (in bytes) of each logical block transferred over the SCSI bus. A block length of 0 indicates that the length is variable (as specified in the I/O command). Any other value indicates the number of bytes per block that are used for READ, WRITE, and VERIFY type commands that specify a fixed bit of 1 (Fixed Block Mode).

4.10.3 MODE SENSE Mode Pages

The following figure depicts the variable length page descriptor.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS	0	Page Code					
1	Additional Page Length							
2	Page Defined or Vendor Specific Parameter Bytes							

Figure 4-61. MODE SENSE Page Descriptor — Data Format

Descriptions of the MODE SENSE page descriptor fields are provided in Table 4-57. Detailed descriptions of each of the MODE SENSE pages follow.

Table 4-57. MODE SENSE Page Descriptor — Field Descriptions

Field Name	Description
PS	Parameters Savable. When 0, the supported parameters cannot be saved (savable pages are not supported). When set to 1, it indicates that the page can be saved in nonvolatile memory by the drive.
Additional Page Length	This field indicates the number of bytes in the page. Note that this value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.

Page codes and pages that are supported are:

Table 4-58. Supported MODE SENSE Block Descriptor Pages and Page Codes

Page Code	Description	SENSE / SELECT	Refer to
00h	No Requested Page	SENSE	---
01h	Read / Write Error Recovery Page	BOTH	Page 4-74
02h	Disconnect / Reconnect Page	BOTH	Page 4-76
0Ah	Control Mode Page	BOTH	Page 4-78
0Fh	Data Compression Page	BOTH	Page 4-80
10h	Device Configuration Page	BOTH	Page 4-82
11h	Medium Partition Page	BOTH	Page 4-85
1Ch	TapeAlert Page	BOTH	Page 4-86
25h	Vendor Specific Configuration Page	BOTH	Page 4-89
3Ch	Disaster Recovery Control Page	BOTH	Page 4-91
3Eh	EEPROM Vendor Specific Page	BOTH	Page 4-91
3Fh	All Pages (except EEPROM)	SENSE	---

Read / Write Error Recovery Page (01h)

The tape drive supports the Error Recovery Page for READ and WRITE operations. The format for the page is shown below.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (01h)					
1	Additional Page Length (0Ah)							
2	Rsv'd	Rsv'd	TB (0)	Rsv'd	EER (1)	PER	DTE (0)	DCR (0)
3	READ Retry Count							
4 - 7	Reserved							
8	WRITE Retry Count							
9 - 11	Reserved							

Figure 4-62. Read / Write Error Recovery Page — Data Format

Table 4-59. Read / Write Error Recovery Page — Field Descriptions

Field Name	Description
PS	Parameters Savable. Must be 0, the supported parameters cannot be saved (savable pages are not supported).
Additional Page Length	This field indicates the number of bytes in the page. Note that this value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.
TB	Transfer Block. The Transfer Block (when not fully recovered) function is not supported.
EER	Enable Early Recovery. This function is always enabled (must be = 1).
PER	Parity Error. This bit enables reporting of CHECK CONDITION for recovered READ / WRITE errors. Default is 0.
DTE	Disable Transfer on Error. Set to 0. This feature is not supported.
DCR	Disable ECC Correction Bit. Set to 0. This feature is not supported.
READ Retry Count	This field reports the maximum number of re-reads that are attempted before declaring an unrecoverable error.
WRITE Retry Count	This field reports the maximum number or overwrite retries that are attempted before declaring an unrecoverable error.

Disconnect / Reconnect Page (02h)

The tape drive supports the Disconnect / Reconnect Page. The format for the page is shown in the following figure.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (02h)					
1	Additional Page Length (0Eh)							
2	Buffer Full Ratio (0)							
3	Buffer Empty Ratio (0)							
4 - 5	(MSB) Bus Inactivity Limit (0) (LSB)							
6 - 7	(MSB) Disconnect Time Limit (0) (LSB)							
8 - 9	(MSB) Connect Time Limit (0) (LSB)							
10 - 11	(MSB) Maximum Burst Size (LSB)							
12	Reserved							DTDC
13 - 15	Reserved							

Figure 4-63. Disconnect / Reconnect Page — Data Format

Table 4-60. Disconnect / Reconnect Page — Field Descriptions

Field Name	Description
PS	Parameters Savable. When 0, the supported parameters cannot be saved (savable pages are not supported). When set to 1, it indicates that the page can be saved in nonvolatile memory by the drive.
Additional Page Length	This field indicates the number of bytes in the page. Note that this value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.
Buffer Full Ratio	Not supported.
Buffer Empty Ratio	Not supported.
Bus Inactivity Limit	Not supported.
Disconnect Time Limit	Not supported.
Connect Time Limit	Not supported.
Maximum Burst Size	The value in this field specifies the maximum amount of data to be transferred without disconnecting. A value of 0 sets no limit. This value is given in 512 byte increments. For example, a value of 8 indicates 4K bytes. Values that are not multiples of 8 are rounded up to the nearest multiple of 8.
DTDC	Data Transfer Disconnect Control. The value in this field specifies the restriction when a disconnect is permitted.

Control Mode Page (0Ah)

The Control Mode Page allows the user to determine whether the tape drive returns a CHECK CONDITION status when one of the WRITE and READ counters has reached a specified threshold.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (0Ah)					
1	Page Length (06)							
2	Reserved							RLEC
3	Queue Algorithm Modifier (0)				Reserved			
4	EECA (0)	Reserved				RAENP (0)	UAAENP (0)	EAENP (0)
5	Reserved							
6 - 7	(MSB) Ready AEN Holdoff Period (0) (LSB)							

Figure 4-64. Control Mode Page — Data Format

Table 4-61. Control Mode Page — Field Descriptions

Field Name	Description
PS	Parameters Savable. When 0, the supported parameters cannot be saved (savable pages are not supported). When set to 1, it indicates that the page can be saved in nonvolatile memory by the drive.
Page Length	The value in this field indicates the number of bytes in the Control Mode Page being transferred. The value for this byte is 06h.
RLEC	Report Log Exception Condition. This bit indicates whether the tape drive returns CHECK CONDITION status with sense key set to UNIT ATTENTION (06h) when one of its WRITE and READ error counters reaches a specified threshold, as follows: 0 = Do not return UNIT ATTENTION when a threshold has been met. 1 = Return UNIT ATTENTION when a threshold is met.
Queue Algorithm Modifier	Must be 0.

Table 4-61. Control Mode Page — Field Descriptions (Continued)

Field Name	Description
QErr	Queue Error. Must be 0.
DQue	Disable Queuing. Must be 0.
EECA	Enable Extended Contingent Allegiance. Not supported; must be 0.
RAENP	Ready AEN Permission. Asynchronous event notification is not supported; must be 0.
UAAENP	Unit Attention AEN Permission. Not supported; must be 0.
EAENP	Enable AEN Permission. Asynchronous event notification is not supported; must be 0.
Ready AEN Holdoff Period	Not supported. Must be 0.

Data Compression Page (0Fh)

The Data Compression page specifies parameters for the control of data compression.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved	Page Code (0Fh)					
1	Page Length (0Eh)							
2	DCE	DCC (1)	Reserved					
3	DDE (0)	RED (0)		Reserved				
4 - 7	(MSB) Compression Algorithm (10h) (LSB)							
8 - 11	(MSB) Decompression Algorithm (LSB)							
12 - 15	(MSB) Reserved (LSB)							

Figure 4-65. Data Compression Page — Data Format

Table 4-62. Data Compression Page — Field Descriptions

Field Name	Description
PS	Parameters Savable. Not supported; must be 0.
Page Length	The value in this field indicates the number of bytes in the Control Mode Page being transferred. The value for this byte is 0Eh.
DCE	Data Compression Enable. The value returned for this bit depends on the current WRITE density of the tape drive: 0 = Write compression is Disabled 1 = Write compression is Enabled
DCC	Data Compression Capable. The value returned for this bit indicates whether this tape drive supports data compression. 0 = Data compression is Disabled 1 = Data compression is Enabled
DDE	Data Decompression Enable. The value returned for this bit indicates whether data decompression is enabled or not. 0 = Data decompression is Disabled 1 = Data decompression is Enabled Note that when the tape drive reads compressed data from tape, it automatically decompresses the data before sending it to the initiator. The value for this bit, therefore, is always 1.
RED	Report Exception on Decompression. The tape drive does not report exceptions on decompression (boundaries between compressed and decompressed data). The value returned for RED is 00h.
Compression Algorithm	The value for this field is 10h. This indicates the Lempel-Ziv high efficiency data compression algorithm.
Decompression Algorithm	The value for this field is 10h. This indicates the Lempel-Ziv high efficiency data decompression algorithm. If EEPROM parameter EnaRepDCcomp is set, a value of 0 is reported if the last block read is not decompressed.

Device Configuration Page (10h)

The tape drive supports the Device Configuration Page. The format for the page is shown below.

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (10h)					
1	Additional Page Length (0Eh)							
2	Reserved	CAP (0)	CAF (0)	Active Format (0)				
3	Active Partition (0)							
4	WRITE Buffer Full Ratio (0)							
5	READ Buffer Empty Ratio (0)							
6 - 7	(MSB) WRITE Delay Time (LSB)							
8	DBR (0)	BIS (0)	RSmk (0)	AVC (0)	SOCF (0)		RBO (0)	REW (0)
9	Gap Size (0)							
10	EOD Defined (0)			EEG (1)	SEW (1)	Reserved		
11 - 13	(MSB) Buffer Size at Early Warning (0) (LSB)							
14	Select Data Compression Algorithm							
15	Reserved							

Figure 4-66. Device Configuration Page — Data Format

Table 4-63. Device Configuration Page — Field Descriptions

Field Name	Description
PS	Parameters Savable. Not supported; must be 0.
Additional Page Length	This field indicates the number of bytes in the page. Note that this value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.
CAP	Change Active Partition. Not supported.
CAF	Change Active Format. Not supported.
Active Format	Not supported.
Active Partition	This field indicates the current logical partition number in use. Only partition 0 is supported.
WRITE Buffer Full Ratio	Indicates how full the buffer should be before restarting writing to the medium. The tape drive sets this to 0 (unused) since it uses an automatic adaptive mechanism to dynamically adjust its ratio according to the average data rates over the SCSI bus.
READ Buffer Empty Ratio	Indicates how empty the buffer should be before restarting reading from the medium. The tape drive sets this to 0 (unused) since it uses an automatic adaptive mechanism to dynamically adjust its ratio according to the average data rates over the SCSI bus.
WRITE Delay Time	Indicates the maximum time (in 100 ms increments) the drive waits with a partially fully buffer before forcing the data to tape. Note that the buffer full/empty ratio, which is dynamic, can cause data to be written sooner than the WRITE delay time value indicates. The WRITE delay time defaults to 100 (64h). This causes the buffer to be flushed in 10 seconds. Minimum value is 15 (Fh); maximum value is 6500 (1964h). This represents a range in delay from 1.5 seconds to 11 minutes.
DBR	Data Buffer Recovery. Not supported; set to 0.
BIS	Block Identifiers Supported. Set to 1.
RSmk	Report Setmarks. Not supported; set to 0.
AVC	Automatic Velocity Control. Set to 0.
SOCF	Stop on Consecutive Filemarks. Set to 0.
RBO	Recover Buffer Order. Set to 0.
REW	Report Early Warning. Set to 0 (do not report early warning EOM on reads).

Table 4-63. Device Configuration Page — Field Descriptions (Continued)

Field Name	Description
Gap Size	Not supported. Set to 0.
EOD Defined	End of Data. Set to 00h.
EEG	Enable EOD Generation Bit. Set to 1 to indicate that the drive generates an EOD. The drive generates an EOD mark before any change of direction following a WRITE-type operation.
SEW	Synchronize at Early Warning. When set to 1, any unwritten data or tapemarks are written to the medium before each command completes once the End of Medium early warning point is reached, effectively operating as if in unbuffered mode. When set to 0, the drive continues to operate in buffered mode, if enabled, past the End of Medium early warning point. Default value is 1.
Buffer Size at Early Warning	Not supported; must be 0.
Select Data Compression Algorithm	If set to 1, data compression is enabled. If 0, data compression is disabled.

Medium Partition Page (11h)

The tape drive supports the Medium Partition Page. The format for the page is shown below.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (11h)					
1	Additional Page Length (06h)							
2	Maximum Additional Partitions (0)							
3	Additional Partitions Defined (0)							
4	FDP (0)	SDP (0)	IDP (0)	PSUM (0)	Reserved			
5	Medium Format Recognition (01h)							
6 - 7	Reserved							

Figure 4-67. Medium Partition Page — Data Format

Table 4-64. Medium Partition Page — Field Descriptions

Field Name	Description
PS	Parameters Savable. Not supported; must be 0.
Additional Page Length	This field indicates the number of bytes in the page. Note that this value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.
Maximum Additional Partitions	Not supported. Set to 0.
Additional Partitions Defined	This field specifies the number of additional partitions to be defined for the tape based on the settings of the SDP and IDP bits. The maximum allowed is the value returned in the Maximum Additional Partitions field. Since only one partition is supported, this field must be 0.
FDP	Fixed Data Partitions. Set to 0.
SDP	Select Data Partitions. Set to 0.
IDP	Initiator Defined Patrons. Set to 0.
PSUM	Partition Size Unit of Measure. Set to 0.
Medium Format Recognition	Set to 01h, indicating that automatic format recognition is supported.

TapeAlert Page (1Ch)

The TapeAlert configuration settings can be read via the MODE SENSE command's TapeAlert Page.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (1Ch)					
1	Additional Page Length (0A)							
2	Perf (0)	Reserved			DExcpt	Test (0)	Re-served	LogErr (0)
3	Reserved				MRIE			
4 - 7	(MSB) Interval Timer (0) (LSB)							
8 - 11	(MSB) Report Count / Test Flag Number (0) (LSB)							

Figure 4-68. TapeAlert Page Format Descriptor — Data Format

Table 4-65. TapeAlert Page Format Descriptor — Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Additional Page Length	This field indicates the number bytes in the page. However, the value does not include bytes 0 and 1. The length is returned in MODE SENSE commands and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The drive returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receives an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.
Perf	Performance bit. Not supported.
DExcpt	Disable Information Exception Operations. Default value is 1. When this bit is set to 0, the reporting method specified by the contents of MRIE is selected. When this bit is set to 1, all information exception operations are disabled and the contents of the MRIE field are ignored. When in this mode, the TapeAlert Log page is polled by the software.
Test	Always 0.
LogErr	Error Log. Not supported.

Table 4-65. TapeAlert Page Format Descriptor — Field Descriptions (Continued)

Field Name	Description	
MRIE	Method for Reporting Informational Exceptions. The tape drive uses the contents of this field to report information about exception conditions. Four methods are available:	
	Value	**Method**
	00h	No reporting of Informational Exception Conditions. The device server does not report information exception conditions.
	03h	Conditionally Generate Recovered Error; this value is the default. The device server reports informational exception conditions, if such reports of recovered errors is allowed, by returning CHECK CONDITION status on the next SCSI command (except INQUIRY and REQUEST SENSE commands) following detection of the condition. The sense key is set to RECOVERED ERROR with an additional sense code of 5D/00 (TapeAlert Event). The SCSI command with CHECK CONDITION completes without error prior to the report of any exception condition, and does not need to be repeated.
	4h	Unconditionally Generate Recovered Error. The drive reports informational exception conditions by returning CHECK CONDITION status on the next SCSI command (except INQUIRY and REQUEST SENSE commands) following detection of the condition. The sense key is set to RECOVERED ERROR with an additional sense code of 5D/00 (TapeAlert Event). The SCSI command with CHECK CONDITION completes without error prior to the report of any exception condition, and does not need to be repeated.
	06h	Only Report Informational Exception Condition on Request. The device server preserves information exception data. To access the data, a poll can be taken by issuing an unsolicited REQUEST SENSE command. The sense key is set to NO SENSE with an additional sense code of 5D/00 (TapeAlert Event).
	The additional sense code of 5D/00 for values 03h and 06h signals that a TapeAlert has occurred. Information about the event is stored in the TapeAlert Log Page. The setting of MRIE does not impact logging of events in the TapeAlert Log Page.	
Interval Timer	Always 0.	
Report Count / Test Flag Number	Always 0.	

Vendor Specific Configuration Control Page (25h)

This page controls the operation of the Vendor Specific Configuration Control Mode for the drive.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsv'd	Page Code (25h)					
1	Page Length (8)							
2	Default Density Override							
3 - 9	Reserved							

Figure 4-69. Vendor Specific Configuration Control Page — Data Format

Table 4-66. Vendor Specific Configuration Control Page — Field Description

Field Name	Description
Default Density Override	The following density codes are the *preferred* codes used to define density. **Code** **Description** 00h Density override disabled. 48h 133000 bpi, 56 logical tracks, serial cartridge tape - 110.0 GB / 220.0 GB (Super DLTtape I) 49h 190000 bpi, 56 logical tracks, serial cartridge tape - 160.0 GB / 320.0 GB (Super DLTtape I) This one-byte field holds the setting of the density desired on a write from BOT. It can be set at any time, but will zeroed out during a cartridge load. Therefore, for the override to be meaningful, it must be set after the cartridge is loaded. After being set, its value will override any application resetting the drive to default density (0) via a MODE SELECT command.

Disaster Recovery Control Page (3Ch)

This page controls the operation of the Disaster Recovery Control Mode for the drive.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsv'd	Page Code (3Ch)					
1	Page Length (4)							
2	Reserved							DRAct
3 - 5	Reserved							

Figure 4-70. Disaster Recovery Control Page — Data Format

Table 4-67. Disaster Recovery Control Page — Field Description

Field Name	Description
DRAct	Disaster Recovery Active. When set to 1, the drive is operating in Disaster Recovery mode.

EEPROM Vendor Specific Page (3Eh)

The Super DLTtape drive supports the EEPROM Vendor Specific page (3Eh). All the EEPROM parameters that can be set via the MODE SELECT EEPROM Vendor Specific page are returned.

Because of the length of the list of EEPROM parameters, a 10-byte MODE SENSE command is required. If a 6-byte MODE SENSE command is used for retrieval, the data is returned as follows:

```
Send a 10-byte MODE SENSE command to get the Parameter List.
```

The data returned by the 10-byte MODE SENSE command for the EEPROM page is in the form of a MODE SENSE (10) data header followed by block and page descriptors.

The data in the page descriptor is organized in the form of a parameter header followed by the actual parameter's value. The parameter is as follows:

```
Name   T   Current    Default   Minimum   Maximum
```

Name refers to the parameter name, for example, ProductID or DefaultCompOn.

T designates data type: "b" indicates binary, "A" indicates string type, and if there is no designator, the data is in decimal format.

Current, Default, Minimum, and Maximum specify the current, default, minimum, and maximum values of the parameter.

4.11 PERSISTENT RESERVE IN Command (5Eh)

The PERSISTENT RESERVE IN command is a 10-byte command used to obtain information about persistent reservations and registrations that are active within a device server. It is used in conjunction with the PERSISTENT RESERVE OUT command.

The following figure illustrates the format of the PERSISTENT RESERVE IN command; the table that follows explains the data fields of the command.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (5Eh)							
1	Reserved			Service Action				
2 - 6	Reserved							
7 - 8	(MSB) Allocation Length (LSB)							
9	Control							

Figure 4-71. PERSISTENT RESERVE IN Command Descriptor Block — Data Format

Table 4-68. PERSISTENT RESERVE IN Command — Field Descriptions

Field Name	Description
Service Action	Service action codes available are: **Code** / **Name** / **Description** 00h / Read Keys / Reads all registered reservation keys 01h / Read Reservations / Reads all current persistent reservations 02-1Fh / Reserved / Reserved A Read Keys service action requests that the device server return a parameter list that includes a header and a complete list of all of the reservation keys currently registered with the device server. If multiple initiators have registered with the same key, then the key is listed multiple times, once for each registration. Refer to Figure 4-72 on page 4-125 and Table 4-69 on page 4-126 for information about Read Keys parameter data.

Table 4-68. PERSISTENT RESERVE IN Command — Field Descriptions (Continued)

Field Name	Description
	A Read Reservation service action requests that the device server return a parameter list that contains a header and a complete list of all persistent reservations that are presently active in the device server. Refer to Figure 4-73 and Table 4-70 for information about Read Reservations parameter data.
Allocation Length	This field indicates how much space has been reserved for the returned parameter list (Read Keys or Read Reservations parameters). The actual length of the parameter data is indicated in the parameter data field for those parameters. If the Allocation Length is not sufficient to contain the entire list of parameters, the first portion of the list that does fit is returned. If it is determined that the remainder of the list is required, the client should send a new PERSISTENT RESERVE IN command with an Allocation Length field large enough to contain the entire list of parameters.

The figure and table below illustrate and describe the data fields of Read Key data parameters.

Bit Byte	7	6	5	4	3	2	1	0
0 - 3	(MSB) Generation (LSB)							
4 - 7	(MSB) Additional Length (*n* – 7) (LSB)							
(Reservation Key List Follows in Bytes 8 – *n*)								
8 - 15	(MSB) First Reservation Key (LSB)							
n **- 7 to n**	(MSB) Last Reservation Key (LSB)							

Figure 4-72. Read Keys Parameters — Data Format

Table 4-69. Read Keys Parameters — Field Descriptions

Field Name	Description
Generation	The value in this field is a 32-bit counter in the device server that is incremented each time a PERSISTENT RESERVE OUT command requests a Register, Clear, Pre-empt, or Pre-empt and Clear operation. Note that PERSISTENT RESERVE IN commands do not increment the counter, nor do PERSISTENT RESERVE OUT commands that perform a Reserve or Release service action, or by a PERSISTENT RESERVE OUT command that is not done due to an error or a reservation conflict. The value in the Generation field is set to 0 as part of the power-on reset processes. The value in the Generation field allows the application client that examines the value to verify that the configuration of the initiators attached to a logical unit has not been modified by another application client without any notification of the application client doing the examination.
Additional Length	This field contains the count of the number of bytes that are in the Reservation Key list (bytes 8 – *n*). Note that this field contains the number of bytes in the reservation key list regardless of the value prescribed by the Allocation Length field in the command's CDB.
Reservation Keys	Each of the Reservation Keys appear as items in a list as bytes 8 through *n*. Each entry reflects an 8-byte reservation key registered with the device server via the PERSISTENT RESERVE OUT Register or Register and Ignore Existing Key service actions. Each key can be examined by the application client for correlation with a set of initiators and SCSI ports.

The following figure and table illustrate and describe the data fields of Read Reservations data parameters.

Bit Byte	7	6	5	4	3	2	1	0
0 - 3	(MSB) Generation (LSB)							
4 - 7	(MSB) Additional Length (*n* – 7) (LSB)							
8 - *n*	(MSB) Reservation Descriptors (LSB)							

Figure 4-73. Read Reservations Parameters — Data Format

Table 4-70. Read Reservations Parameters — Field Descriptions

Field Name	Description
Generation	The value in this field is a 32-bit counter in the device server that is incremented each time a PERSISTENT RESERVE OUT command requests a Register, Clear, Pre-empt, or Pre-empt and Clear operation. Note that PERSISTENT RESERVE IN commands do not increment the counter, nor do PERSISTENT RESERVE OUT commands that perform a Reserve or Release service action, or by a PERSISTENT RESERVE OUT command that is not done due to an error or a reservation conflict. The value in the Generation field is set to 0 as part of the power on reset processes. The value in the Generation field allows the application client that examines the value to verify that the configuration of the initiators attached to a logical unit has not been modified by another application client without any notification of the application client doing the examination.
Additional Length	This field contains the count of the number of bytes of Reservation descriptors (bytes 8 – *n*). Note that this field contains the number of bytes regardless of the value prescribed by the Allocation Length field in the command's CDB.
Reservation Descriptors	One Reservation descriptor is reported for each unique persistent reservation on the logical unit when the PERSISTENT RESERVE IN command has indicated a Read Reservations action. Figure 4-74 on page 4-128 and Table 4-71 on page 4-128 contain details about the contents of each Reservation Descriptors field.

The figure and table below illustrate and describe the data fields of each Read Reservations descriptor's data fields.

Bit Byte	7	6	5	4	3	2	1	0
0 - 7	(MSB) Reservation Key (LSB)							
8 - 11	(MSB) Scope-Specific Address (LSB)							
12	Reserved							
13	Scope				Type			
14 - 15	Obsolete							

Figure 4-74. PERSISTENT RESERVE IN Read Reservations Descriptor — Data Format

Table 4-71. PERSISTENT RESERVE IN Read Reservations Descriptor — Field Descriptions

Field Name	Description
Reservation Key	The Reservation key field contains an 8-byte value that identifies the reservation key under which the persistent reservation is held.
Scope-Specific Address	Used to indicate the element that the reservation affects when a reservation is for an element rather than a logical unit. The Super DLTtape does not support reservations of elements, so this field is always 0.
Scope	The value in this field indicates whether a persistent reservation applies to an entire logical unit, to a part of the logical unit (defined as an extent), or to an element. The Super DLTtape drive only supports reservations of the entire logical unit, indicated by setting this field to 0.
Type	The value of the Type field specifies the characteristics of the persistent reservation being established for all data blocks within the extent or within the logical unit. Refer to Table 4-72 for the applicable Type codes and their meanings.

Table 4-72 describes the available “Type” values from the Type field of the PERSISTENT RESERVE IN Read Reservations parameters.

Each of the codes provides handling instructions for READ operations, for WRITE operations, and for subsequent attempts to establish persistent reservations (referred to as “Additional Reservations Allowed” in the table).

Table 4-72. PERSISTENT RESERVATION IN Type Codes

Code	Name	Description
0h	Obsolete	
1h	WRITE Exclusive	READS: Shared; any application client on any initiator may execute commands that perform transfers from the target to the initiator. WRITES: Exclusive; any command from any initiator other than the initiator that holds the persistent reservation that attempts a transfer to the target results in a reservation conflict. ADDITIONAL RESERVATIONS: Allowed; any initiator may reserve the logical unit, extents, or elements as long as the persistent reservations do not conflict with any reservations already known to the device server.
2h	Obsolete	
3h	Exclusive Access	READS: Exclusive; any command from any initiator other than the initiator holding the persistent reservation that attempts a transfer from the target results in a reservation conflict. WRITES: Exclusive; any command from any initiator other than the initiator holding the persistent reservation that attempts a transfer to the target results in a reservation conflict. ADDITIONAL RESERVATIONS: Restricted; any PERSISTENT RESERVE OUT command with the Reserve service action from any initiator other than the initiator holding the persistent reservation results in a reservation conflict. The initiator that holds the persistent reservation can reserve the logical unit, extents, or elements as long as the persistent reservations do not conflict with any reservations already known to the device server.
4h	Obsolete	

Table 4-72. PERSISTENT RESERVATION IN Type Codes (Continued)

Code	Name	Description
5h	WRITE Exclusive Registrants Only	READS: Shared; any application client on any initiator may execute commands that perform transfers from the target to the initiator. WRITES: Exclusive; any command from an initiator that has not previously performed a Register service action with the device server that attempts a transfer to the target results in a reservation conflict. ADDITIONAL RESERVATIONS: Allowed; any initiator may reserve the logical unit, extents, or elements as long as the persistent reservations to not conflict with any reservations already known to the device server.
6h	Exclusive Access Registrants Only	READS: Exclusive; any command from an initiator that has not previously performed a Register service action with the device server that attempts a transfer from the target results in a reservation conflict. WRITES: Exclusive; any command from an initiator that has not previously performed a Register service action with the device server that attempts a transfer to the target results in a reservation conflict ADDITIONAL RESERVATIONS: Allowed; any initiator may reserve the logical unit, extents, or elements as long as the persistent reservations to not conflict with any reservations already known to the device server.
7h - Fh	Reserved	Not applicable

4.12 PERSISTENT RESERVE OUT Command (5Fh)

The PERSISTENT RESERVE OUT command is a 10-byte command used to reserve a logical unit for the exclusive or shared use by an initiator. The command is used in conjunction with the PERSISTENT RESERVE IN command; it is not used with the RESERVE and RELEASE commands.

Persistent reservations conflict with reservations made via the RESERVE command. Initiators that perform PERSISTENT RESERVE OUT actions are identified by a reservation key assigned by the application client. The client may use the PERSISTENT RESERVE IN command to identify which other initiators within a system hold conflicting or invalid persistent reservations and use the PERSISTENT RESERVE OUT command to preempt those reservations if necessary.

Note that since persistent reservations are not reset by the SCSI Bus reset of BUS DEVICE RESET (TARGET RESET) or other global actions, they can be used to enact device sharing among multiple initiators. The PERSISTENT RESERVE OUT and PERSISTENT RESERVE IN commands provide the means for resolving contentions in multiple-initiator systems with multiple port target. By using the reservation key to identify persistent reservations, it is possible to determine which ports hold conflicting persistent reservations and to take over such reservations from failing or “greedy” initiators.

The following figure illustrates the format of the PERSISTENT RESERVE OUT command; the table that follows explains the data fields of the command.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (5Fh)							
1	Reserved			Service Action				
2	Scope				Type			
3 - 6	Reserved							
7 - 8	(MSB) Parameter List Length (18h) (LSB)							
9	Control							

Figure 4-75. PERSISTENT RESERVE OUT Command Descriptor Block — Data Format

Table 4-73. PERSISTENT RESERVE OUT Command — Field Descriptions

Field Name	Description		
Service Action	Service action codes available are:		
	Code	**Name**	**Description**
	00h	Register	Register a reservation key with the device server
	01h	Reserve	Create a persistent reservation using a reservation key
	02h	Release	Release a persistent reservation
	03h	Clear	Clear all reservation keys and all persistent reservations
	04h	Pre-empt	Pre-empt persistent reservations from another initiator
	05h	Pre-empt & Clear	Pre-empt persistent reservations from another initiator and clear the task set for the pre-empted initiator
	06h	Register & Ignore Existing Key	Register a reservation key with the device server. Existing reservation key is ignored.
	07-1Fh	Reserved	Reserved
	Refer to Table 4-74 on page 4-134 for detailed descriptions of each of the service action codes.		
Scope	The value in this field indicates whether a persistent reservation applies to an entire logical unit or to an element. The Super DLTtape only supports reservations of the entire logical unit, indicated by setting this field to 0.		
Type	The value of the Type field specifies the characteristics of the persistent reservation being established for all data blocks within the extent or within the logical unit. Refer to Table 4-75 on page 4-138 for the applicable Type codes and their meanings.		
Parameter List Length	Fields contained in the PERSISTENT RESERVE OUT parameter list specify the reservation keys and extent information required to perform a persistent reservation service action. The parameter list is 24 bytes in length; the Parameter List Length field contains 24 (18h).		

The following table provides detailed descriptions of each of the PERSISTENT RESERVE OUT command's seven possible service actions (Service Action codes appear in bits 0 – 4 of Byte 1).

Table 4-74. PERSISTENT RESERVE OUT Command's Service Action Descriptions

Code	Name	Description
00h	Register	When the command executes a Register service action, it registers a reservation key with a device server without generating a reservation. The device server holds these reservation keys from each initiator that performs a PERSISTENT RESERVE OUT command with a Register service action until the key is changed by a new PERSISTENT RESERVE OUT command with Register service action from the same initiator, or until the initiator registration is removed by: • Powering down the logical unit, if the last Activate Persist Through Power Loss (APTPL; see Figure 4-76 on page 4-139 and Table 4-76 on page 4-140) received by the device server was 0: • Performing a Clear service action; • Performing a Pre-empt service action; • Performing a Pre-empt and Clear service action; or • Performing a Register service action from the same initiator with the value of the service action reservation key set to 0. When a reservation key has not yet been established or when the reservation key has been removed, a reservation key of 0 is used when the initiator performs a PERSISTENT RESERVE OUT with the Register service action. When the reservation has been removed, no information is reported for the initiator in the Read Keys service action of the resulting PERSISTENT RESERVE IN command.
01h	Reserved	A PERSISTENT RESERVE OUT command with Reserve service action creates a persistent reservation with a specified Scope and Type. Persistent reservations are not superseded by a new persistent reservation from any initiator except by the execution of a PERSISTENT RESERVE OUT command that specifies a Release, Clear, Pre-empt, or Pre-empt and Clear service action.

Table 4-74. PERSISTENT RESERVE OUT Command's Service Action Descriptions

Code	Name	Description
02h	Release	A PERSISTENT RESERVE OUT command with Release service action removes a persistent reservation held by the same initiator. The fields associated with a Release service action match fields of the active persistent reservation. Sending of a PERSISTENT RESERVE OUT command that specifies a Release service action when no persistent reservation exists from that initiator does not result in an error. Instead, the device server returns a GOOD status without altering any other reservation: the reservation key is not changed by the Release service action. The device server returns a CHECK CONDITION status for any PERSISTENT RESERVE OUT command that specifies the release of a persistent reservation held by the requesting initiator that does not match the Scope and Type. The sense key is set to ILLEGAL REQUEST and additional sense data is set to INVALID RELEASE OF ACTIVE PERSISTENT RESERVATION. Attempts to release persistent reservations in which none of the Scope, Type, Reservation Key, and extent values match an existing persistent reservation held by the initiator making the request are not errors. An active persistent reservation may also be released by: • Powering off. When the most recent APTPL value received by the device server is 0, a power-off performs a hard reset, clears all persistent reservations, and removes all registered reservation keys; or • Executing a PERSISTENT RESERVE OUT command from another initiator with a persistent reserve service action of Clear, Pre-empt, or Pre-empt and Clear. Note that a Release service action should not be performed if any operations interlocked by the persistent reservation have not yet completed.
03h	Clear	A PERSISTENT RESERVE OUT command with a successful Clear service action removes all persistent reservations for all initiators. All reservation keys are also removed. Any commands from any initiator that have been accepted by the device server as non-conflicting continue their normal executions. A UNIT ATTENTION condition is established for all registered initiators for the logical unit. The sense key is set to UNIT ATTENTION; the additional sense data is set to RESERVATIONS PREEMPTED. Note that applications should not use the Clear action service except during recoveries associated with initiator or system reconfiguration, since data integrity may be compromised.

Table 4-74. PERSISTENT RESERVE OUT Command's Service Action Descriptions

Code	Name	Description
04h	Pre-empt	A PERSISTENT RESERVE OUT command with a successful Pre-empt service action removes all persistent reservations for all initiators that have been registered with the Service action Reservation key specified in the PERSISTENT RESERVE OUT command's parameter list. A persistent reservation is also established for the pre-empting initiator. Any commands from any initiator that have been accepted by the device server as non-conflicting continue their normal executions. If a PERSISTENT RESERVE OUT command is sent that specifies a Pre-empt service action and no persistent reservation exists for the initiator identified by the Service action Reservation key, it is not an error condition. A UNIT ATTENTION condition is established for the pre-empted initiators. The sense key is set to UNIT ATTENTION; the additional sense data is set to RESERVATIONS PREEMPTED. Commands that follow are subject to the persistent reservation restrictions set by the pre-empting initiator. The persistent reservation thus created by the pre-empting initiator is defined by the Scope and Type fields of the PERSISTENT RESERVE OUT command and the corresponding fields of the command's parameter list. The registration keys for the pre-empted initiators are removed by the Pre-empt service action; the reservation key for an initiator that has performed a Pre-empt service action with its own Reservation key specified in the Service action Reservation key remains unchanged, although all other specified releasing actions and reservation actions are performed. Note that persistent reservations are not superseded by a new persistent reservation from any initiator except by the execution of a PERSISTENT RESERVE OUT that specifies either the Pre-empt or the Pre-empt and Clear service actions. New persistent reservations that do not conflict with an existing persistent reservation execute normally.

Table 4-74. PERSISTENT RESERVE OUT Command's Service Action Descriptions

Code	Name	Description
05h	Pre-empt & Clear	A PERSISTENT RESERVE OUT command with a Pre-empt & Clear service action removes all persistent reservations for all initiators that have been registered with the Service action Reservation key specified in the PERSISTENT RESERVE OUT command's parameter list. It also establishes a persistent reservation for the pre-empting initiator. Any commands from the initiators being pre-empted are terminated as if an ABORT TASK management function had been performed by the pre-empted initiator. If a PERSISTENT RESERVE OUT command is sent that specifies a Pre-empt & Clear service action and no persistent reservation exists for the initiator identified by the Service action Reservation key, it is not an error condition. If the key is registered, however, the Clear portion of the action executes normally. A UNIT ATTENTION condition is established for the pre-empted initiators. The sense key is set to UNIT ATTENTION; the additional sense data is set to RESERVATIONS PREEMPTED. Commands that follow, and retries of commands that timed out because there were cleared are subject to the persistent reservation restrictions set by the pre-empting initiator. The persistent reservation thus created by the pre-empting initiator is defined by the Scope and Type fields of the PERSISTENT RESERVE OUT command and the corresponding fields of the command's parameter list. The Pre-empt & Clear service action clears any CA condition with the initiator that is pre-empted. The reservation key for the other initiators pre-empted are removed by the Pre-empt & Clear service action. The reservation key for an initiator that has sent a Pre-empt & Clear action with its own reservation key specified in the service action's reservation key remains unchanged, although all other specified clearing actions, releasing actions, and reservation actions are performed. Persistent reservations are not superseded by a new persistent reservation from any initiator except via execution of a PERSISTENT RESERVE OUT that specifies either the Pre-empt or Pre-empt & Clear service action. New persistent reservations not in conflict with an existing persistent reservation execute normally.
06h	Register and Ignore Key	This service action functions the same as the Register (00h) action except the reservation key in the parameter list is ignored and treated as if it matched the current registration, if one exists for the initiator.

The following table presents the definitions of the available “Type” values from the Type field of the PERSISTENT RESERVE OUT Read Reservations parameters.

Each of the codes provides handling instructions for READ operations, for WRITE operations, and for subsequent attempts to establish persistent reservations (referred to as “Additional Reservations Allowed” in the table).

Table 4-75. PERSISTENT RESERVE OUT Type Codes

Code	Name	Description
0h	Obsolete	
1h	WRITE Exclusive	READS: Shared; any application client on any initiator may execute commands that perform transfers from the storage medium to the initiator. WRITES: Exclusive; any command from any initiator other than the initiator that holds the persistent reservation that attempts a transfer to the storage medium results in a reservation conflict.
2h	Obsolete	
3h	Exclusive Access	READS: Exclusive; any command from any initiator other than the initiator holding the persistent reservation that attempts a transfer from the storage medium results in a reservation conflict. WRITES: Exclusive; any command from any initiator other than the initiator holding the persistent reservation that attempts a transfer to the storage medium results in a reservation conflict.
4h	Obsolete	
5h	WRITE Exclusive Registrants Only	READS: Shared; any application client on any initiator may execute commands that perform transfers from the storage medium to the initiator. WRITES: Exclusive; any command from an initiator that has not previously performed a Register service action with the device server that attempts a transfer to the storage medium results in a reservation conflict.
6h	Exclusive Access Registrants Only	READS: Exclusive; any command from an initiator that has not previously performed a Register service action with the device server that attempts a transfer from the storage medium results in a reservation conflict. WRITES: Exclusive; any command from an initiator that has not previously performed a Register service action with the device server that attempts a transfer to the storage medium results in a reservation conflict.
7h - Fh	Reserved	Not applicable

The PERSISTENT RESERVE OUT command requires a parameter list, shown in the following figure and defined in the following table. Each of the fields of the parameter list are sent for every PERSISTENT RESERVE OUT command, even if the field is not required for the specific Service action and/or Scope values.

Bit Byte	7	6	5	4	3	2	1	0
0 - 7	(MSB) Reservation Key (LSB)							
8 - 15	(MSB) Service Action Reservation Key (LSB)							
16 - 19	(MSB) Scope-Specific Address (LSB)							
20	Reserved							APTPL
21	Reserved							
22 - 23	Obsolete							

Figure 4-76. PERSISTENT RESERVE OUT Parameter List — Data Format

Table 4-76. PERSISTENT RESERVE OUT Parameter List — Field Descriptions

Field Name	Description
Reservation Key	This field contains an 8-byte token that is provided by the application client to the device server to identify which initiator is the source of the PERSISTENT RESERVE OUT command. For all service actions except Register and Ignore Existing Key, the device server verifies that the Reservation Key in the PERSISTENT RESERVE OUT command matches the Reservation Key that is registered for the initiator from which the command is received. If there is no match, the device server returns a RESERVATION CONFLICT status. The Reservation Key of the initiator is valid for all Service action and Scope values.
Service Action Reservation Key	This field contains information needed for three different service actions: the Register service action, the Pre-empt service action, and the Pre-empt & Clear service action. The Service Action Reservation Key is ignored for all other service actions. For the Register service action, the Service Action Reservation Key field contains the new Reservation Key to be registered. For the Pre-empt and the Pre-empt & Clear service actions, the Service Action Reservation Key contains the reservation key of the persistent reservations that are being pre-empted. For the Pre-empt and the Pre-empt & Clear actions, any failure of the Service Action Reservation Key to match any registered keys results in the device server returning a RESERVATION CONFLICT status.
Scope-Specific Address	Ignored.
APTPL	Activate Persist Through Power Loss. This bit is valid only for Register and Register and Ignore Existing Key service actions; it is ignored for all other types of service actions. If the last valid APTPL bit value received by the device server is 0, the loss of power in the target releases any persistent reservations and removes all reservation keys. If the last valid APTPL bit value is 1, the logical unit retains all persistent reservations and all reservation keys for all initiators even if power is lost and later returned. The most recently received valid APTPL value from any initiator governs the logical unit's behavior in the event of a power loss.

The following table illustrates which fields are set by the application client and interpreted by the device server for each Service and Scope value.

Table 4-77. Device Server Interpretation of Service and Scope Value

		Parameters		
Service Action	**Allowed Scope**	**Type**	**Service Action Reservation Key**	**Reservation Key**
Register	Ignored	Ignored	Valid	Valid
Reserve	LU	Valid	Ignored	Valid
Release	LU	Valid	Ignored	Valid
Clear	Ignored	Ignored	Ignored	Valid
Pre-empt	LU	Valid	Valid	Valid
Pre-empt & Clear	LU	Valid	Valid	Valid
Register and Ignore Existing Key	Ignored	Ignored	Valid	Ignored

4.13 PREVENT / ALLOW MEDIUM REMOVAL Command (1Eh)

This command enables or disables the unloading of the tape cartridge.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Eh)							
1	Logical Unit Number			Reserved				
2 - 3	Reserved							
4	Reserved							Prevent
5	Unused		Reserved				Flag	Link

Figure 4-77. PREVENT / ALLOW MEDIUM REMOVAL Command Descriptor Block — Data Format

Table 4-78. PREVENT / ALLOW MEDIUM REMOVAL Command Descriptor Block — Field Descriptions

Field Name	Description
Prevent	When set to 1, the Eject button on the drive's front panel is effectively disabled, and the UNLOAD command does not unload the tape medium or the cartridge. The PREVENT / ALLOW status in the device is maintained separately by each initiator. When set to 0, the Prevent state corresponding to that initiator is cleared. When all initiators have cleared their Prevent states, the Eject button and UNLOAD commands are enabled. By default, after power-on, a SCSI reset condition, or BUS DEVICE RESET message, the PREVENT MEDIUM REMOVAL function is cleared. If the drive is in a tape automation system, library, or loader, any MOVE MEDIUM command is prevented from removing a cartridge once Prevent has been enabled.

4.14 READ Command (08h)

The READ command transfers one or more data blocks or bytes to the initiator starting with the next block on the tape.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (08h)							
1	Logical Unit Number			Reserved			SILI	Fixed
2 - 4	(MSB) Transfer Length (LSB)							
5	Unused		Reserved				Flag	Link

Figure 4-78. READ Command Descriptor Block — Data Format

Table 4-79. READ Command Descriptor Block — Field Descriptions

Field Name	Description
SILI	Suppress Incorrect Length Indicator. If the SILI bit is set to 1 and the Fixed bit is set to 1, the target terminates the command with CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code of INVALID FIELD IN CDB. If the SILI bit is 0 and the actual block length is different than the specified transfer length, a CHECK CONDITION status is returned. Within the sense data, the Incorrect Length Indicator (ILI) bit and Valid bit will be set to 1. The sense key field specifies NO SENSE. The information bytes are set to the difference (residue) between the requested transfer length and the actual block length, or, in Fixed Block mode, the difference (residue) between the requested number of blocks and the actual number of blocks read. No more than transfer length blocks are transferred to the initiator and the tape is logically positioned after the block (EOM side).

Table 4-79. READ Command Descriptor Block — Field Descriptions (Continued)

Field Name	Description
	If the SILI bit is set to 1, the drive will: a) Report CHECK CONDITION status for an incorrect length condition only if the overlength condition exists and the BLOCK LENGTH field in the mode parameter block descriptor is nonzero; or b) not report CHECK CONDITION status if the only error is the underlength condition, or if the only error is the overlength condition and the BLOCK LENGTH field of the mode parameters block descriptor is zero.
Fixed	This bit specifies whether fixed-length or variable-length blocks are to be transferred, and gives meaning to the Transfer Length field of the READ command. When set to 0, variable-block mode is requested. A single block is transferred with the Transfer Length specifying the maximum number of bytes the initiator has allocated for the returned data. When the Fixed bit is set to 1, the Transfer Length specifies the number of blocks to be transferred to the initiator. This is valid only if the logical unit is currently operating in Fixed Block mode. When the Transfer Length is 0, no data is transferred and the current position on the logical unit does not change. This is not an error condition. A successful READ with Fixed bit set to 1 transfers (current block length) x (# of blocks x block size) bytes of data to the host. Upon termination of READ, the medium is logically positioned after the last block of data transferred (EOM side).

Filemark and End-of-Data Handling

If the tape drive reads a Filemark, it returns a CHECK CONDITION status. Within the sense data, the Filemark and Valid bits are set and the Sense Key field is set to NO SENSE. The information fields contain the residue count. The Additional Sense Code and Additional Sense Code Qualifier fields are set to FILEMARK DETECTED. Upon termination, the medium is logically positioned after the Filemark.

If the drive detects End-of-Data (EOD) during a READ, the drive returns a CHECK CONDITION status. Within the sense data, the Valid bit is set and the Sense Key field is set to BLANK CHECK. The information fields contain the residue count. The Additional Sense Code Qualifier fields are set. Upon termination, the medium is physically positioned after the last block on tape.

End-of-Medium/Partition Handling

The meaning of EOM is different for a READ command than for a WRITE-related command. EOM is reported only when the physical EOM or End-of-Partition (EOP) is encountered. The drive returns a CHECK CONDITION status. The EOM and Valid bits are set and the Sense Key field is set to MEDIUM ERROR. The information fields contain the residue count and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P DETECTED. The tape is physically positioned at EOM/P.

4.15 READ BLOCK LIMITS Command (05h)

The READ BLOCK LIMITS command directs the tape drive to report its block length limits.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (05h)							
1	Logical Unit Number			Reserved				
2 - 4	Reserved							
5	Unused		Reserved				Flag	Link

Figure 4-79. READ BLOCK LIMITS Command Descriptor Block — Data Format

The READ BLOCK LIMITS data shown below is sent during the DATA IN phase of the command. The command does not reflect the currently selected block size, only the available limits. MODE SENSE is the command that returns the current block size.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved			Granularity (0)				
1 - 3	(MSB) Maximum Block Length (LSB)							
4 - 5	(MSB) Minimum Block Length (LSB)							

Figure 4-80. READ BLOCK LIMITS Data — Data Format

Table 4-80. READ BLOCK LIMITS Data — Field Descriptions

Field Name	Description
Granularity	This field indicates the granularity of block sizes supported by the device. Block sizes must be an even multiple of the value "2" raised to the granularity power. This field will contain 0 for all densities indicating any block size between the minimum and the maximum is acceptable.
Maximum Block Length	The value in this field indicates the maximum block length. The tape drive supports a maximum block length of 16,777,215 (16 MB-1) for DLT formats. For Super DLTtape formats, the maximum block length is 16,777,212 (16 MB - 4).
Minimum Block Length	The value in this field indicates the minimum block length. Minimum block lengths vary depending on the format the drive is using. For Super DLTtape format, the minimum block length is 4.

4.16 READ BUFFER Command (3Ch)

The READ BUFFER command is used in conjunction with WRITE BUFFER as a diagnostic function for testing the drive's data buffer for possible diagnostic data and for checking the integrity of the SCSI bus. In addition, by using buffers 1 and 2, the READ BUFFER command allows the contents of the tape system's local RAM/EEPROM, and DRAM to be transferred over the SCSI bus. Buffers 1 and 2 provide a diagnostic capability for the system's firmware.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Ch)							
1	Logical Unit Number			Reserved	Mode			
2	Buffer ID							
3 - 5	(MSB) Buffer Offset (LSB)							
6 - 8	(MSB) Allocation Length (LSB)							
9	Unused		Reserved				Flag	Link

Figure 4-81. READ BUFFER Command Descriptor Block — Data Format

Table 4-81. READ BUFFER Command Descriptor Block — Field Descriptions

Field Name	Description
Mode	The tape drive supports the following values within this field. If any non-supported value is set, the drive terminates the command with a CHECK CONDITION status, ILLEGAL REQUEST sense key set: **Mode** — **Description** 0000b — Combined Header and Data (see page 4-150) 0010b — Data Mode (see page 4-150) 0011b — Descriptor Mode (see page 4-151) 1010b — Echo Buffer (see page 4-151) 1011b — Echo Buffer Descriptor (see page 4-152)
Buffer ID	The Buffer ID field indicates from which buffer the data is to be transferred. Meaningful values are 0, 1, and 2. In Combined Header and Data mode and Data mode, any other value is illegal. In Descriptor mode, any other value returns all zeros in the descriptor. In Echo Buffer and Echo Buffer Descriptor modes, this field is ignored. Buffer 0 - This 2200 KB buffer is intended to be used in conjunction with the WRITE BUFFER command to provide a diagnostic capability for testing the SCSI bus and/or hardware integrity. Buffer 1 - This buffer is used to read the tape system's SCSI RAM and EEPROM. Its effective size is 30200h bytes. Buffer 2 - This buffer is used to read the tape system's data cache RAM. The Available Length field returned in Combined Header and Data Mode and the Buffer Capacity field returned in Descriptor Mode are not large enough to express the size of the data cache RAM, so both fields return to zero.
Buffer Offset	The Buffer Offset field allows the host to specify the location of the start of the data within the buffer. This field is reserved and must be 0 for all modes except Data and Descriptor.
Allocation Length	This field specifies the maximum number of bytes that the initiator has allocated for returning data. The host uses this field to limit the size of data transfers to its own internal buffer size.

The host should first send a READ BUFFER command, in Descriptor mode, to determine the size of the buffer being returned. In response to the READ BUFFER command, the tape system returns four bytes of data, three of which contain the size of the buffer. The host can then use this data to establish the Buffer Offset/ Allocation Length fields of the CDB. Once the size of the buffer is known, Mode 2 (Data Only, see "Data Mode (0010b)" on page 4-150) can be used to transfer the data across the SCSI bus.

4.16.1 Combined Header and Data Mode (0000b)

In this mode, the tape drive returns a 4-byte header followed by data bytes. The drive terminates the DATA IN phase when the Allocation Length bytes of header and data have been transferred or when all available data has been transferred to the initiator, whichever is less. The 4-byte READ BUFFER header is followed by data bytes from the target data buffer. The figure below illustrates the format of the header.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1 - 3	(MSB) Available Length (LSB)							

Figure 4-82. READ BUFFER Header — Data Format

Table 4-82. READ BUFFER Header — Field Description

Field Name	Description
Available Length	This field specifies the total number of data bytes available in the target's buffer. This number is not reduced to reflect the allocation length, nor is it reduced to reflect the actual number bytes written using the WRITE BUFFER command. Following the READ BUFFER header, the target transfers data from its data buffer.

4.16.2 Data Mode (0010b)

In this mode, the DATA IN phase contains only buffer data.

4.16.3 Descriptor Mode (0011b)

In this mode, a maximum of four bytes of READ BUFFER descriptor information is returned. The tape drive returns the descriptor information for the buffer specified by the Buffer ID. In this mode, the drive does not reject the invalid Buffer IDs with a CHECK CONDITION status, but returns all zeros in the READ BUFFER descriptor. The Offset Boundary is 3, indicating that buffer offsets should be integral multiples of 8.

Bit Byte	7	6	5	4	3	2	1	0
0	Offset Boundaries (0Ch)							
1 - 3	(MSB) Buffer Capacity (LSB)							

Figure 4-83. READ BUFFER Descriptor — Data Format

4.16.4 Read Data from Echo Buffer (1010b)

In this mode the drive transfers data to the application client from the Echo Buffer. The Echo Buffer will transfer the same data as when the WRITE BUFFER command with the mode field set to Echo Buffer was issued. The Buffer ID and Buffer Offset fields are ignored in this mode.

The READ BUFFER command will return the same number of bytes of data as received in the prior echo buffer mode WRITE BUFFER command from the same initiator. If a prior Echo Buffer mode WRITE BUFFER command was not successfully completed, the Echo Buffer mode READ BUFFER command will terminate with a CHECK CONDITION status, the sense key shall be set to ILLEGAL REQUEST and the additional sense code to COMMAND SEQUENCE ERROR. If the data in the Echo Buffer has been overwritten by another initiator the drive will terminate the command with a CHECK CONDITION status, the sense key will be set to ABORTED COMMAND and the additional sense code to ECHO BUFFER OVERWRITTEN.

4.16.5 Echo Buffer Descriptor Mode (1011b)

In this mode, a maximum of four bytes of READ BUFFER descriptor information is returned. The drive will return the descriptor information for the Echo Buffer. The Buffer Offset field is reserved in this mode. The allocation length should be set to four or greater. The drive shall transfer the lesser of the allocation length or four bytes of READ BUFFER descriptor.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved							EBOS
1	Reserved							
2	Reserved				Buffer Capacity			
3	Buffer Capacity							

Figure 4-84. ECHO BUFFER Descriptor — Data Format

Table 4-83. ECHO BUFFER Descriptor — Field Descriptions

Field Name	Description
EBOS	Echo Buffer Overwritten Supported. Set to 1 to indicate the drive will return the ECHO BUFFER OVERWRITTEN Additional Sense Code if the data being read from the Echo Buffer is not the data previously written by the same initiator.
Buffer Capacity	Returns 252 (always) indicating the size of the Echo Buffer.

4.17 READ POSITION Command (34h)

The READ POSITION command is used to read a position identifier or SCSI Logical Block Address (LBA). The LOCATE command uses this identifier to position back to this same logical position in a high-performance fashion.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (34h)							
1	Logical Unit Number				Reservd	TCLP	LONG	BT
2 - 8	Reserved							
9	Unused		Reserved				Flag	Link

Figure 4-85. READ POSITION Command Descriptor Block — Data Format

Table 4-84. READ POSITION Command Descriptor Block — Field Descriptions

Field Name	Description
TCLP	Total Current Logical Position. When set to 1, the data returned includes Block, Filemark, and Setmark position and fits the format described in "Total Current Logical Position" on page 4-156. When set to 0, the data returned uses the SCSI-2 format described in "Standard Read Position Data" on page 4-154.
LONG	When the Long field is set to 1, it indicates the device server shall return 32 bytes of data. A Long bit of 0 indicates the device server will return 20 bytes of data. The Long bit and the TCLP bit must both be one or both be zero. If Long and TCLP have different values, the drive will return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST.
BT	Block Type. This bit indicates how the position is to be interpreted. Since the tape drive uses the same logical block regardless of the setting of this bit, the setting is ignored. The logical block address values include all recorded objects: blocks and filemarks.

4.17.1 Standard Read Position Data

Data returned when the TCLP and the Long bits are both set to 0 takes the following form:

Bit Byte	7	6	5	4	3	2	1	0
0	BOP	EOP	BCU	BYCU	Reserved	BPU (0)	PERR	Reserved
1	Partition Number							
2 - 3	Reserved							
4 - 7	(MSB) First Block Location (LSB)							
8 - 11	(MSB) Last Block Location (LSB)							
12	Reserved							
13 - 15	(MSB) Number of Blocks in Buffer (LSB)							
16 - 19	(MSB) Number of Bytes in Buffer (LSB)							

Figure 4-86. READ POSITION (Short Form) — Data Format

Table 4-85. READ POSITION (Short Form) Data — Field Descriptions

Field Name	Description
BOP	Beginning of Partition. When set to 1, indicates that the logical unit is at the beginning of partition in the current partition. When 0, indicates that the current logical position is not at the beginning of partition. Since the tape drive does not support more than one partition, the value of this field will be 1 when at BOT.
EOP	End of Partition. When set to 1, indicates that the logical unit is positioned between early warning and the end of partition in the current partition. When 0, it indicates that the current logical position is not between early warning and end of partition.
BCU	Block Count Unknown.
BYCU	Byte Count Unknown.
BPU	Block Position Unknown. This bit is never set.
PERR	Position Error.
First Block Location	The block address associated with the current logical position: the next block to be transferred between the target and initiator if a READ or WRITE command is issued.
Last Block Location	The block address associated with the current physical position: the next block to be transferred to tape medium and from the target's buffer. If the buffer is empty, or has only a partial block, the same value as First Block Location is reported. The first block or filemark written onto the tape medium is at address 0.
Number of Blocks in Buffer	The number of data blocks in the target's buffer that have not been written to the medium.
Number of Bytes in Buffer	The number of data bytes in the buffer that have not been written to the tape medium.

4.17.2 Total Current Logical Position

Data returned when the TCLP and the Long bits are both set to 1 takes the following form:

Bit Byte	7	6	5	4	3	2	1	0
0	BOP	EOP	Reserved		MPU	BPU	Reserved	
1 - 3	Reserved							
4 - 7	(MSB) Partition Number (LSB)							
8 - 15	(MSB) Block Number (LSB)							
16 - 23	(MSB) File Number (LSB)							
24 - 31	(MSB) Set Number (LSB)							

Figure 4-87. READ POSITION (Long Form) — Data Format

Table 4-86. READ POSITION (Long Form) Data — Field Descriptions

Field Name	Description
BOP	Beginning of Partition. When set to 1, indicates that the logical unit is at the beginning of partition in the current partition. When 0, indicates that the current logical position is not at the beginning of partition. Since the tape drive does not support more than one partition, the value of this field will be 1 when at BOT.
EOP	End of Partition. When set to 1, indicates that the logical unit is positioned between early warning and the end of partition in the current partition. When 0, it indicates that the current logical position is not between early warning and end of partition.
MPU	Mark Position Unknown. The values in File Number and Set Number are not valid.
BPU	Block Position Unknown. This bit is never set.
Partition Number	The partition number for the current logical position.
Block Number	The number of logical blocks between the beginning of partition and the current logical position. Filemarks and Setmarks count as one logical block each.
File Number	The number of Filemarks between the beginning of partition and the current logical position.
Set Number	The number of Setmarks between the beginning of partition and the current logical position.

4.18 RECEIVE DIAGNOSTIC RESULTS Command (1Ch)

The RECEIVE DIAGNOSTIC RESULTS command fetches the results of the last SEND DIAGNOSTIC command sent to the tape drive.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ch)							
1	Logical Unit Number			Reserved				
2	Reserved							
3 - 4	(MSB) Allocation Length (LSB)							
5	Unused		Reserved				Flag	Link

Figure 4-88. RECEIVE DIAGNOSTIC RESULTS Command Descriptor Block — Data Format

Table 4-87. RECEIVE DIAGNOSTIC RESULTS Command Data — Field Descriptions

Field Name	Description
Allocation Length	Specifies the number of bytes of diagnostic page results the drive is allowed to send to the initiator.

The following data is returned by the drive as a result of the RECEIVE DIAGNOSTIC command. Note that a REQUEST SENSE command should be used to obtain more detailed information following a CHECK CONDITION on a SEND DIAGNOSTIC command.

Bit Byte	7	6	5	4	3	2	1	0
0	Controller Present Flag							
1	Controller Error Flag							
2	Drive Present Flag							
3	Drive Error Flag							
4	Media Loader Present Flag							
5	Media Loader Error Flag							
Flag set (1) = Failure Flag not set (0) = Not present or no error								

Figure 4-89. RECEIVE DIAGNOSTIC RESULTS — Data Format

This information indicates which of the main components of the tape drive subsystem may have failed diagnostic testing.

4.19 RELEASE (10) Command (57h)

The RELEASE and the RESERVE commands are used for contention resolution in multiple-initiator systems. The RELEASE (10) command is used to release a previously reserved logical unit. The drive will not return an error if the initiator attempts to release a reservation that is not currently valid.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (57h)							
1	Reserved			3rdPty	Reserved		LongID	Extent (0)
2	Reservation Identification							
3	Third Party Device ID							
4 - 6	Reserved							
7 - 8	(MSB) Parameter List Length (LSB)							
9	Control							

Figure 4-90. RELEASE (10) Command Descriptor Block — Data Format

Table 4-88. RELEASE (10) Command — Field Descriptions

Field Name	Description
3rd Party	Third Party Release allows an initiator to release a logical unit that was previously reserved. If the value in this field is 0, third party release is not requested. If 3rdPty = 1, then the device server shall release the specified logical unit, but only if the initiator ID, 3rdPty bit, and third party device ID are identical when compared to the RESERVE command that established the reservation.
Long ID	If the Long ID bit is set to 1, the Parameter List Length is 8 and the eight bytes of the parameter list carry the device ID of the third party device; the contents of the Third Party Device ID in the CDB (byte 3) are ignored.
Extent	The drive supports reservations only on entire logical units. **The value must be 0.**
Reservation Identification	Any value in this field is ignored by the drive.
Third Party Device ID	If the Third Party Device ID value that is connected with the reservation release is smaller than 255, the LongID bit may be 0 and the ID value sent in the CDB. If LongID bit = 0, the Parameter List Length field also = 0. If the Third Party Device ID value is greater than 255, LongID = 1.
Parameter List Length	The contents of this field specify the length, in bytes, of the parameter list that will be transferred from the initiator to the target.

Note: Assuming that the RELEASE Command Descriptor Block is valid, the drive always returns a GOOD status for this command. An actual release only happens if the initiator has the unit reserved for itself or a third-party initiator.

If the LongID bit = 1 and the Extent bit = 0, then the parameter list length is eight and the parameter list has the following format.

Bit Byte	7	6	5	4	3	2	1	0
0 - 7	(MSB) Third Party Device ID (LSB)							

Figure 4-91. RELEASE (10) ID Only Parameter List — Data Format

4.20 RELEASE UNIT Command (17h)

The RELEASE UNIT command releases the drive if it is currently reserved by the requesting initiator. It is not an error to release the tape drive if it is not currently reserved by the requesting initiator. If the tape drive is reserved by another initiator, however, it is not released; the tape drive is only released from the initiator that issued the RELEASE UNIT command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (17h)							
1	Logical Unit Number			3rd Pty	Third Party Device ID			Rsv'd
2 - 4	Reserved							
5	Unused		Reserved				Flag	Link

Figure 4-92. RELEASE UNIT Command Descriptor Block — Data Format

Table 4-89. RELEASE UNIT Command Data — Field Descriptions

Field Name	Description
3rdPty	The third party release option for RELEASE UNIT allows an initiator to release a logical unit that was previously reserved using the third-party reservation option. If this bit is 0, then the third-party release option is not requested. If this bit is set to 1, the drive is released if it was originally reserved by the same initiator using the third-party reservation option and if the tape drive is the same SCSI device specified in the Third Party Device ID field.
Third Party Device ID	Required if the 3rdPty bit is 1. This field specifies the SCSI ID of the initiator whose third party reservation is being released. This field must be set if the initiator of the original third party RESERVE is the source of the RELEASE.

Note: The 3rdPty and Third Party Device ID fields have been removed from this command in SCSI-3. It is strongly recommended that you use the RELEASE (10) command for third party reservations in all new implementations.

4.21 REPORT DENSITY SUPPORT Command (44h)

The REPORT DENSITY SUPPORT command is a 10-byte command used to request that information about the densities supported by the logical unit is sent to the application client. Note that a reservation conflict will occur when a REPORT DENSITY SUPPORT command is received from any initiator other than the one holding a logical unit reservation.

The figure below illustrates the format of the REPORT DENSITY SUPPORT command; the table that follows explains the data fields of the command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (44h)							
1	Reserved							Media
2 - 6	Reserved							
7 - 8	(MSB) Allocation Length (LSB)							
9	Control							

Figure 4-93. REPORT DENSITY SUPPORT Command Descriptor Block — Data Format

Table 4-90. REPORT DENSITY SUPPORT Command — Field Descriptions

Field Name	Description
Media	When this bit = 0, it indicates that the device server will return density support data blocks for densities supported by the logical unit for *any supported medium*. When this bit = 1, it indicates that the device server will return density support data blocks for densities supported by the *mounted medium*.
Allocation Length	This value in this field specifies the maximum number of bytes that the device server may return.

The REPORT DENSITY SUPPORT command returns a header followed by one or more density support data blocks. The data blocks are presented in ascending numerical order of the primary density code value.

The following figure illustrates the REPORT DENSITY SUPPORT header.

Bit Byte	7	6	5	4	3	2	1	0
0 - 1	(MSB) Available Density Support Length (LSB)							
2 - 3	Reserved							
4 - n	Density Support Data Block Descriptors							

Figure 4-94. REPORT DENSITY SUPPORT Header — Data Format

The following table provides a description of the Available Density Support Length field; the Density Support Data Block Descriptors field has a separate illustration and description table.

Table 4-91. REPORT DENSITY SUPPORT Header — Field Descriptions

Field Name	Description
Available Density Support Length	This value within this field specifies the number of bytes in the data that follows available to be transferred. Note that this length value does not include this field. The value within this field is equal to 2 more than an integer multiple of 52 (the length in bytes of a density support data block descriptor).
Allocation Length	This value in this field specifies the maximum number of bytes that the device server may return.

The figure and table that follow provide information about the Density Support Data Block Descriptor field of the header.

Bit Byte	7	6	5	4	3	2	1	0
0	Primary Density Code							
1	Secondary Density Code							
2	WRTOK	DUP	DEFLT	Reserved				
3 - 4	Reserved							
5 - 7	(MSB) Bits Per MM (LSB)							
8 - 9	(MSB) Media Width (LSB)							
10 - 11	(MSB) Tracks (LSB)							
12 - 15	(MSB) Capacity (LSB)							
16 - 23	(MSB) Assigning Organization (LSB)							
24 - 31	(MSB) Density Name (LSB)							
32 - 51	(MSB) Description (LSB)							

Figure 4-95. REPORT DENSITY SUPPORT Data Block Descriptor — Data Format

Table 4-92. REPORT DENSITY SUPPORT Data Block Descriptor — Field Descriptions

Field Name	Description
Primary Density Code	This field contains the value returned by a MODE SENSE command for the density described in the remainder of the Density Support Data Block Descriptor.
Secondary Density Code	When multiple density code values are assigned to the same recording technology, this field lists the equivalent density code value. If no secondary density code exists, the device server returns the primary device code value in this field.
WrtOK	Write OK. When this bit = 0, it indicates that the drive does not support writing to the media with this density. When this bit = 1, it indicates that the drive is capable of writing this density to either the currently mounted medium (if Media bit in the Command Block Descriptor = 1) or for some media (if the Media bit in the Command Block Descriptor = 0). Note that all density code values returned by the REPORT DENSITY SUPPORT command are supported for READ operations.
DUP	Duplicated. When this bit = 0, it indicates that this Primary Density Code has exactly one density support data block. When this bit = 1, it indicates that this Primary Density Code is specified in more than one density support data block.
Deflt	Default. When this bit = 0, it indicates that this is not the default density of the tape drive. If either the Primary Density Code or the Secondary Density Code is 0, the DEFLT bit will be 1. If neither the Primary or Secondary Density Code is 0 and DEFLT is 1, the logical unit will accept a MODE SELECT header with a density code of 00h as equivalent to the Primary and Secondary Density Codes. The default density of the logical unit may vary depending on the currently mounted media. Multiple codes may return a DEFLT bit of 1 when the Media bit is 0 since more than one default may be possible.
Bit Per MM	Bits per millimeter. The value in this field indicates the number of bits per millimeter per track as recorded on the tape medium. Note that the value is rounded up if the fractional value of the actual value is greater than or equal to 0.5. A value of 00h indicates that the number of bits per millimeter does not apply to this logical unit.
Media Width	The value in this field indicates the width of the tape medium supported by this density. This field has units in tenths of millimeters.
Tracks	The value in this field indicates the number of data tracks supported on the medium by this density.

Table 4-92. REPORT DENSITY SUPPORT Data Block Descriptor — Field Descriptions (Continued)

Field Name	Description
Capacity	If the Media bit = 0, the Capacity field indicates the approximate capacity of the longest supported medium. If the Media bit = 1, the Capacity field indicates the approximate capacity of the current medium. The capacity assumes that compression is disabled. If this density does not support an uncompressed format, the capacity assumes that compression is enabled using "average" data. The capacity also assumes that the media is in good condition and that normal data and block sizes are used. The value is given in units of megabytes (10^6 bytes). Note that the logical unit does not guarantee that this space is actually available in all cases. The Capacity field is intended to be used by the client to determine that the correct density is being used, especially when a lower density format is required.
Assigning Organization	This field contains 8 bytes of ASCII data identifying the organization responsible for the specifications that define the values in the density support data block.
Density Name	This field contains 8 bytes of ASCII data identifying the document that is associated with this density support data block.
Description	This field contains 20 bytes of ASCII data describing the density.

4.22 REPORT DEVICE IDENTIFIER Command (A3h)

The REPORT DEVICE IDENTIFIER command requests that the device server send device identification information to the applicable client.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (A3h)							
1	Reserved			Service Action (05h)				
2 - 5	Reserved							
6 - 9	(MSB) Allocation Length (LSB)							
10	Reserved							
11	Control							

Figure 4-96. REPORT DEVICE IDENTIFIER Command Descriptor Block — Data Format

Table 4-93. REPORT DEVICE IDENTIFIER Command Descriptor Block — Field Descriptions

Field	Description
Service Action	Must be 05h. Any other value will return Check Condition, Illegal request.
Allocation Length	If the Allocation Length is not sufficient to contain all the parameter data, the first portion of the data shall be returned. This shall not be considered an error. The actual length of the parameter data is available in the Identifier Length field in the parameter data. If the remainder of the parameter data is required, the application client should send a new REPORT DEVICE IDENTIFIER command with an Allocation Length field large enough to contain all the data.

The REPORT DEVICE IDENTIFIER parameter list contains a four-byte field that contains the length in bytes of the parameter list and the logical unit's identifier.

Bit Byte	7	6	5	4	3	2	1	0
0 - 3	(MSB) Identifier Length (n – 4) (LSB)							
4 - n	Identifier							

Figure 4-97. REPORT DEVICE IDENTIFIER — Data Format

Table 4-94. REPORT DEVICE IDENTIFIER Parameter Data — Field Descriptions

Field	Description
Identifier Length	Specifies the length in bytes of the Identifier field. If the Allocation Length field in the CDB is too small to transfer all of the identifier, the length is not adjusted to reflect the truncation. The identifier length is initially equal to zero, and is changed only by a successful SET DEVICE IDENTIFIER command.
Identifier	The value reported is the last value written by a successful SET DEVICE IDENTIFIER command. The value of the identifier is changed only by a successful SET DEVICE IDENTIFIER command. The identifier value persists through resets, power cycles, media WRITE operations, and media replacement.

4.23 REPORT LUNS Command (A0h)

The REPORT LUNS command requests that the peripheral device logical unit numbers of known logical units in the target be sent to the applications client. The command only returns information about the logical units to which commands may be sent.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (A0h)							
1 - 5	Reserved							
6 – 9	(MSB) Allocation Length (LSB)							
10	Reserved							
11	Control							

Figure 4-98. REPORT LUNS Command Descriptor Block — Data Format

Table 4-95. REPORT LUNS Command Descriptor Block — Field Description

Field	Description
Allocation Length	If the Allocation Length is not sufficient to contain the logical unit number values for all configured logical units, the device server still reports as many logical number values as will fit in the Allocation Length. The format of the report of configured logical units is shown in Figure 4-99 on page 4-171.

Bit Byte	7	6	5	4	3	2	1	0
0 - 3	(MSB) LUN List Length (n – 7) (LSB)							
4 - 7	Reserved							
8 - 15	(MSB) LUN (first LUN) (LSB)							
n-7 – n	LUN (last LUN, if more than one)							

Figure 4-99. LUN Reporting Parameter List — Data Format

The LUN List Length field contains the length in bytes of the LUN list that can be transferred. The LUN list length equals the number of logical unit numbers reported multiplied by eight. If the allocation length in the CDB is too small to allow transfer of information about all of the logical units configured, the LUN list length value is not adjusted to reflect the truncation.

4.24 REQUEST SENSE Command (03h)

The REQUEST SENSE command causes the tape drive to transfer detailed sense data to the initiator.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	Logical Unit Number			Reserved				
2 - 3	Reserved							
4	Allocation Length							
5	Unused		Reserved				Flag	Link

Figure 4-100. REQUEST SENSE Command Descriptor Block — Data Format

Table 4-96. REQUEST SENSE Command Data — Field Descriptions

Field Name	Description
Allocation Length	This field specifies the maximum number of sense bytes to be returned. The tape drive terminates the transfer when this number of bytes has been transferred or when all available sense data has been transferred to the host, whichever is less.

The REQUEST SENSE command causes the tape drive to transfer detailed sense data to the initiator.

The sense data is valid for a CHECK CONDITION or RESERVATION CONFLICT status returned on the previous command. The sense data bytes are preserved by the tape drive until retrieved by a REQUEST SENSE command, or until the receipt of any other command from the same initiator, though some commands, such as INQUIRY, do not change sense data.

If the tape drive receives an unsolicited REQUEST SENSE, it returns sense data with the appropriate values in the End of Media (EOM), Sense Key, Additional Sense Code, and Additional Sense Code Qualifier. The positional information provided reflects the logical position of the tape drive. The tape drive returns information based on the non-diagnostic data in its buffer as well as the data on tape medium. Additionally, bytes 25 through 28 contain the amount of tape to be written in 4KB blocks.

REQUEST SENSE does not cause the drive to flush its buffered data to tape. Therefore, if the host requires the exact physical positioning of the tape medium, it should precede the REQUEST SENSE command with a WRITE FILEMARKS command with length 0 (Immed=0) specified. This forces the tape drive to flush any currently-buffered data to tape. A subsequent REQUEST SENSE command returns the actual physical (and logical) position of the tape drive to the initiator.

The following figure portrays the format of REQUEST SENSE data.

Bit Byte	7	6	5	4	3	2	1	0
0	Valid	Error Code						
1	Segment Number (0)							
2	Filemark	EOM	ILI	Reserved	Sense Key			
3 - 6	(MSB) Information Bytes (LSB)							
7	Additional Sense Length							
8 - 11	(MSB) Command-Specific Information Bytes (LSB)							
12	Additional Sense Code (ASC)							
13	Additional Sense Code Qualifier (ASCQ)							
14	Sub-Assembly Code (0)							
15	SKSV	C/D	Reserved		BPV	Bit Pointer		
16 - 17	(MSB) Field Pointer (LSB)							
18	Internal Status Code (VS)							
19 - 20	Tape Motion Hours							
21 - 24	Power On Hours							
25 - 28	Tape Remaining							
29	Reserved							

Figure 4-101. REQUEST SENSE — Data Format

Table 4-97. REQUEST SENSE Data — Field Descriptions

Field Name	Description
Valid	When set to 1, this field indicates that the Information Bytes field contains valid information as defined in the ANSI SCSI-2 specification.
Error Code	A value of 70h indicates a current error; the report is associated with the most recently received command. A value of 71h indicates a deferred error; the report is associated with a previous command and not as a result of the current command. No other values are returned in this field.
Segment Number	This value of this byte is always 0.
Filemark	This bit indicates that the current command has read a Filemark.
EOM	End of Medium. This bit indicates that an End of Medium condition (End of Partition or Beginning of Partition) exists. The warning is also given by setting the Sense Key to NO SENSE and the Additional Sense Qualifier to End of Partition or Beginning of Partition.
ILI	Incorrect Length Indicator. This bit indicates that the requested logical block length did not match the logical block length of the data on the tape medium. Only READ or VERIFY may cause this bit to be set.
Sense Key	The Sense Key values are described in Table 4-99 on page 4-178.
Information Bytes	These bytes contain the differences (residue) of the requested length minus the actual length in bytes, blocks, or Filemarks, as determined by the command. Negative values are indicated by two's complement notation. The bytes are valid for all READ, WRITE, SPACE, and VERIFY tape commands for which a CHECK CONDITION status has been generated.
Additional Sense Length	This field specifies the number of additional sense bytes to follow. If the Allocation Length of the Command Descriptor Block is too small to transfer all of the Additional Sense bytes, the Additional Sense Length is not adjusted to reflect the truncation.
Command Specific Information Bytes	Command Specific Information Bytes can be logged by the operating system on error conditions. On tape medium errors, such an entry usually contains the current SCSI logical block address.
Additional Sense Code (ASC)	This field (and the field for Additional Sense Code Qualifier) provides additional information about the Sense Key and cause of a CHECK CONDITION status. Additional Sense Codes are discussed in detail in Table 4-99 on page 4-178.

Table 4-97. REQUEST SENSE Data — Field Descriptions (Continued)

Field Name	Description
Additional Sense Code Qualifier (ASCQ)	This field (and the field for Additional Sense Code) provides additional information about the Sense Key and cause of a CHECK CONDITION status. Additional Sense Code Qualifiers are discussed in Table 4-99 on page 4-178.
Sub-Assembly Code	Not used. Returned as 0.
SKSV	Sense-Key Specific Valid. When set to 1, indicates the data in the Sense Key Specific fields is valid.
C/D	Command / Data. When set to 1, this field indicates that the illegal parameter is contained in the Command Descriptor Block. A C/D set to 0 indicates that the illegal parameter is in the Parameter List from the initiator.
BPV	Bit Pointer Valid. When set to 1, this field indicates that the Bit Pointer field is valid and designates which bit of the byte designated by the field pointer is in error. For a multi-bit field, it points to the most significant bit of the field.
Bit Pointer	When BPV is set to 1, this field indicates the most significant bit of the field in error. Reserved fields are treated as individual bit fields (the most significant reserved bit that is set will be indicated rather than the most significant bit of the entire reserved field). When the field in error uses an entire byte, the Bit Pointer field is typically not used (BPV is set to 0).
Field Pointer	If the Sense Key is ILLEGAL REQUEST, this field indicates which byte of the Command Descriptor Block or Parameter List is in error. For a multi-byte field, the most significant byte is indicated. If the Sense Key is NO SENSE, and the Additional Sense Code field in OPERATION IN PROGRESS, this field indicates the progress towards completion as the numerator of a fraction with 65,536 as the denominator.
Internal Status Code	Vendor Specific.
Tape Motion Hours	This field reports the number of tape motion (in other words, head wear) hours. Format is given as a hexadecimal word (2 bytes).
Power On Hours	This field reports the total number of hours that drive power has been applied over the device's lifetime. Format is given as a hexadecimal longword (4 bytes).
Tape Remaining	This field reports the amount of tape remaining in 4 KB (4096 bytes) blocks.

Table 4-98. Supported Sense Keys for REQUEST SENSE Command

Sense Key	Description
0h	NO SENSE. Check the Filemark/EOM/ILI bits and the Additional Sense Code/ Additional Sense Code Qualifier bytes.
1h	RECOVERED ERROR. This can be caused by rounding of Mode Parameters on a MODE SELECT, or may report that READ/WRITE error rates are reaching subsystem specification limits for optimal operation. The device may still be able to continue to function without any unrecovered errors for a long period of time, however. No CHECK CONDITION is generated unless the PER bit of Mode Page 01h is set.
2h	NOT READY. The tape medium is not ready for tape operation commands. Tape medium might not be present in the drive or may be in the process of loading or calibrating.
3h	MEDIUM ERROR. An unrecoverable WRITE, READ, or positioning error has occurred. Detailed device-specific information may be available.
4h	HARDWARE ERROR. The Additional Sense Code / Additional Sense Code Qualifier fields may present more specific information.
5h	ILLEGAL REQUEST. The Command Descriptor Block or supplied parameter data had an unsupported or illegal operation specified. Check the Byte Pointer and Bit Pointer fields for an indication of the field in error.
6h	UNIT ATTENTION. Unit Attentions are created after a device reset, if the medium asynchronously becomes ready to the initiator, if another initiator changes Mode Parameters, and/or if the firmware is updated.
7h	DATA PROTECTED. The current tape medium is write-protected. This can be because the Write Protect switch on the cartridge is in its enabled position or if the tape medium is not the appropriate type, or if a software write protect is issued.
8h	BLANK CHECK. An End of Data or blank tape has been encountered.
Bh	COMMAND ABORTED. This key is generated when a command has been aborted by the tape drive for some reason.
Dh	VOLUME OVERFLOW. This key indicates that the physical end of tape medium has been reached during writing. The initiator ignored the End of Medium condition and continued to write to tape.

Table 4-99 provides the additional sense codes (ASCs) and additional sense code qualifiers (ASCQs) that may be reported. Additional information, explanations, or suggestions for action are included in some of the descriptions.

Table 4-99. Supported ASC / ASCQ (Hex) for REQUEST SENSE Command

Sense Key	ASC	ASCQ	Description
00h	00	00	No Additional Sense Code
NO SENSE	00	01	Unexpected FM Encountered
	00	02	End of Medium (EOM) Encountered
	00	03	SetMark Encountered
	00	04	Beginning of Medium (BOM) Encountered
	00	05	EOD Encountered
	30	05	Cannot Write Medium - Incompatible Error
	5D	00	TapeAlert Failure Prediction Threshold Exceeded
	5D	FF	False Exception Condition
01h	00	17	Clean Requested (Non-Vendor Specific)
RECOVERED ERROR	0A	00	Error Log Overflow
	0A	80	Error Log Generated
	37	00	Rounded Parameter
	3B	08	Repositioning Error
	44	C1	EEPROM Copy 1 Area Bad
	44	C2	EEPROM Copy 2 Area Bad
	47	00	SCSI Parity Error
	48	00	IDE Message Received
	51	00	ERASE Failure
	53	01	Unload Tape Failure
	5B	01	Threshold Condition Met
	5B	02	Log Counter at Maximum
	5D	00	Failure Predictive Threshold Exceeded
	5D	FF	Failure Predictive Threshold Exceeded (False)

Table 4-99. Supported ASC / ASCQ (Hex) for REQUEST SENSE Command

Sense Key	ASC	ASCQ	Description
02h	04	00	Unit Not Ready, Cause Nonreportable
NOT READY	04	01	Unit Not Ready, Calibration in Process
	04	02	Unit Not Ready, LOAD Command Needed (a tape cartridge is loaded but the tape medium is in an unloaded state)
	04	03	Unit Not Ready, Manual Intervention Needed (no tape cartridge is present or a mechanical failure has occurred)
	04	07	Unit Not Ready, Loader Operation in Progress
	25	90	Bad Code Update Image Header
	30	00	Incompatible Medium Installed
	30	02	Incompatible Format
	30	03	Cleaning Cartridge Installed
	3A	00	Medium Not Present
	3E	00	Logical Unit Has Not Self-Configured Yet
	52	00	Cartridge Error, Calibration Failure
	53	00	Media Load or Eject Failed
	5A	01	Operator Media Removal Request
03h	00	00	Medium Error
MEDIUM ERROR	00	17	Cleaning Requested
	0C	00	WRITE Error
	11	00	Unrecovered READ Error
	14	00	Recorded Entity Not Found (logical DLT block not found)
	15	02	Position Error Detected by Read of Medium
	3B	00	Sequential Positioning Error
	3B	08	Repositioning Error
	51	00	ERASE Failure

Table 4-99. Supported ASC / ASCQ (Hex) for REQUEST SENSE Command

Sense Key	ASC	ASCQ	Description
	52	00	Cartridge Error, Calibration Failed
	81	00	Directory Write Error
04h	08	00	LUN Communication Failure
HARDWARE ERROR	08	01	LUN Communication Timeout Failure
	0B	01	Over Temperature Condition Error
	0C	80	Write SCSI FIFO CRC Error
	11	80	Read SCSI FIFO CRC Error
	11	81	Block Port Detected EDC Error
	11	82	Block Port Detected Record CRC Error
	15	01	Random Mechanical Positioning Error
	3B	08	Repositioning Error
	40	84	Diagnostic/POST Failure, POST Soft Failure [1]
	44	00	Internal Target Failure
	44	83	SCSI Chip Gross Error/ Illegal – Command Status
	44	84	Unexpected/Unexplained Residue Count in Transfer Register
	44	85	Immediate Data Transfer Timeout
	44	86	Insufficient CDB Bytes
	44	87	Disconnect/SDP Sequence Failed
	44	88	Bus DMA Transfer Timeout
	44	C1	EEPROM Copy 1 Area Bad
	44	C2	EEPROM Copy 2 Area Bad
	44	C3	Both EEPROM Copy Areas Bad
	47	00	SCSI Parity Error
	51	00	Erase Failure
	53	00	Media Load/Eject Failure
	53	01	Unload Tape Failure

Table 4-99. Supported ASC / ASCQ (Hex) for REQUEST SENSE Command

Sense Key	ASC	ASCQ	Description
	84	01	Basic Health Check (BHC) Diagnostic Test Failed
05h	1A	00	Parameter List Length Error
ILLEGAL REQUEST	20	00	Illegal OpCode
	20	81	Illegal Command While In Recovery Mode
	24	00	Invalid CDB Field (may occur if odd block counts are attempted in fixed mode)
	24	82	Media in Drive
	24	86	Invalid Offset
	24	87	Invalid Size
	24	89	Image Data Over Limit [2]
	24	8B	Image/Personality is Bad [2]
	24	8C	Not Immediate Command
	24	8D	Bad Drive/Server Image EDC [2]
	24	8E	Invalid Personality for Code Update (CUP) [2]
	24	8F	Bad Controller Image EDC [2]
	26	04	Invalid Release of Persistent Reservation
	30	02	Incompatible Format (cannot read medium)
	55	04	Insufficient Registration Resources
	25	00	Illegal LUN
	26	00	Parameter List Error, Invalid Field
	26	01	Parameter List Error, Parameter Not Supported
	26	02	Parameter List Error, Parameter Value Invalid
	30	00	Incompatible Medium (cannot read medium)
	39	00	Saving Parameters Not Supported
	3D	00	Invalid Bits in ID Message
	53	02	Media Removal Prevented
	82	00	Not Allowed if not at BOT

Table 4-99. Supported ASC / ASCQ (Hex) for REQUEST SENSE Command

Sense Key	ASC	ASCQ	Description
06h			
UNIT ATTENTION	28	00	Not Ready to Ready Transition
	29	00	Reset Occurred
	29	01	Power On Occurred
	29	02	SCSI Bus Reset Occurred
	29	03	Bus Device Reset Function Occurred
	29	04	Device Internal Reset
	29	05	Transceiver Mode Changed to Single-Ended
	29	06	Transceiver Mode Changed to LVD
	2A	01	Mode Parameters Changed
	2A	02	Log Parameters Changed
	2A	04	Reservations Released
	2A	05	Registrations Preempted
	3F	01	Microcode has been Changed
	3F	05	Device Identifier Changed
	5B	01	Log Threshold Condition Met
07h	27	01	Hardware Write Protected
DATA PROTECTED	27	02	Logical Unit Software Write Protected
	30	05	Cannot Write Medium - Incompatible Format
08h	00	05	EOD Encountered
BLANK CHECK			
0Bh	1B	00	Synchronous Data Transfer Error
COMMAND ABORTED	43	00	Message Error

Table 4-99. Supported ASC / ASCQ (Hex) for REQUEST SENSE Command

Sense Key	ASC	ASCQ	Description
	44	80	Unexpected Selection Interrupt
	44	82	Command Complete Sequence Failure
	44	83	SCSI Chip, Gross Error/ Illegal – Command Status
	44	84	Unexpected/Unexplained Residue Count in Transfer Register
	44	87	Disconnect/ SDP Sequence Failed
	45	00	Select/Reselect Failure
	47	00	SCSI Parity Error (check SCSI bus configuration and connections)
	48	00	IDE Message Error
	49	00	Invalid Message Error
	4A	00	Command Phase Error
	4B	00	Data Phase Error
	4E	00	Overlapped Commands Attempted (queue tag is not unique, CDB sent with abort tag message, or untagged, or untagged CDBs are outstanding)
0Dh	00	02	End of Medium
VOLUME OVERFLOW			

1. Contact a service representative.
2. Bad firmware image or code download possible.

4.25 RESERVE (10) Command (56h)

The RESERVE and RELEASE commands are used for contention resolution in multiple-initiator systems. The RESERVE command is used to reserve a logical unit number. The RESERVE (10) Command Descriptor Block is shown in Figure 4-102, and the data fields are described in Table 4-100. If RESERVE (10) is used, then RELEASE (10) is also used.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (56h)							
1	Reserved			3rdPty	Reserved		LongID	Extent (0)
2	Reservation Identification							
3	Third Party Device ID							
4 - 6	Reserved							
7 - 8	(MSB) Parameter List Length (LSB)							
9	Control							

Figure 4-102. RESERVE (10) Command Descriptor Block — Data Format

Table 4-100. RESERVE (10) Command — Field Descriptions

Field	Description
3rd Pty	When set to 1, it indicates that the Third Party Device ID field is valid.
LongID	When 0, indicates that the third party device associated with the reservation release has a number smaller than 255 and the ID value can be sent within the CDB. If set = 1, indicates that the third party device ID is greater than 255, the ID value within the CDB is ignored, and the parameter list length is at least eight.
Extent	Not supported. Must be 0.
Reservation Identification	Ignored.
Third Party Device ID	Required and used only when the 3rdPty bit is set, in which case this field specifies the SCSI ID of the initiator to be granted the reservation of the logical unit. The drive ignores any attempt to release the reservation made by any other initiator. For example, if ID7 sends ID2 a Third Party reservation on behalf of ID6 (the target at ID2 gets reserved for the initiator ID6), then only ID7 can release the target at ID2 (using a Third Party release). ID6 cannot release the reservation even though the reservation was made on its behalf.
Parameter List Length	This field specifies the length, in bytes, of the parameter list that will be transferred from the initiator.

If the LongID bit = 1 and the Extent bit = 0, then the parameter list length is eight and the parameter list has the format shown below. The drive preserves the reservation until one of the following occurs:

- It is superseded by another valid RESERVE command from the initiator;
- It is released by the same initiator;
- It is released by a BUS DEVICE RESET message from any initiator; or
- It is released by a SCSI reset condition.

Bit Byte	7	6	5	4	3	2	1	0
0 - 7	(MSB) Third Party Device ID (LSB)							

Figure 4-103. RESERVE (10) ID Only Parameter List — Data Format

4.26 RESERVE UNIT Command (16h)

The RESERVE UNIT command reserves the specified tape drive for exclusive use by the requesting initiator or for another specified SCSI device.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	Logical Unit Number			3rdPty	Third Party Device ID			Rsv'd
2 - 4	Reserved							
5	Unused		Reserved				Flag	Link

Figure 4-104. REQUEST SENSE Command Descriptor Block — Data Format

Table 4-101. RESERVE UNIT Command Data — Field Descriptions

Field Name	Description
3rdPty	The third party reservation option for RESERVE UNIT allows an initiator to reserve a logical unit for another SCSI device. This option is intended for systems that use COPY, and is implemented by the tape drive. If set to 1, logical unit is reserved for the SCSI device whose ID appears in the Third Party Device ID field. The tape drive ignores any attempt made by any other initiator to release the reservation and returns a GOOD status. If set to 0, no third party reservation is requested and device is reserved for the initiator that issued the CDB.
Third Party Device ID	If 3rdPty is set to 1 (indicating that an initiator has reserved the logical unit for another SCSI device), this field contains the ID number of that SCSI device for which the reservation was made.

NOTE: The 3rdPty and Third Party Device ID fields have been removed from this command in SCSI-3. It is strongly recommended that you use the RESERVE (10) command for third party reservations in all new implementations.

A reservation via the RESERVE UNIT command remains in effect until one of the following conditions is met:

- It is superseded by another valid RESERVE UNIT command from the initiator;
- It is released with a RELEASE UNIT command from the same initiator;
- It is released by a BUS DEVICE RESET message from any initiator; or
- It is released by a SCSI reset condition.

The occurrence of the last two conditions is indicated by the drive returning a CHECK CONDITION status, sense key of UNIT ATTENTION on the next command following the condition. It is not an error to issue a RESERVE UNIT command to a drive that is currently reserved by the requesting initiator.

If another initiator has previously reserved the logical unit, the target returns a RESERVATION CONFLICT status.

If, after honoring the reservation, any other initiator attempts to perform any command except INQUIRY, REQUEST SENSE, or RELEASE UNIT, the command is rejected with a RESERVATION CONFLICT status. That logical unit ignores a RELEASE UNIT command issued by another initiator.

An initiator that holds a current reservation may modify that reservation (for example, to switch third parties) by issuing another RESERVE UNIT command to the tape drive.

4.27 REWIND Command (01h)

The REWIND command directs the tape drive to position the tape at the beginning of the currently active partition (for Super DLTtape drives, this is BOM). Before rewinding, the tape drive writes any write data that is in the buffer to the tape medium and appends an End of Data marker.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (01h)							
1	Logical Unit Number			Reserved				Immed
2 - 4	Reserved							
5	Unused		Reserved				Flag	Link

Figure 4-105. REWIND Command Descriptor Block — Data Format

Table 4-102. REWIND Command Data — Field Descriptions

Field Name	Description
Immed	Immediate. If this bit is set to 1, the tape drive first writes any remaining buffered data to tape medium and adds an EOD marker. It then returns status to the host **before** beginning the actual rewind operation. If this bit is 0, status will be sent **after** the rewind has completed.

4.28 SEND DIAGNOSTIC Command (1Dh)

The SEND DIAGNOSTIC command directs the tape drive to perform its self-diagnostic tests.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	Logical Unit Number			PF (0)	Reserved	Selftst	DevOfl	UnitOfl
2	Reserved							
3 - 4	(MSB) Parameter List Length (LSB)							
5	Unused		Reserved				Flag	Link

Figure 4-106. SEND DIAGNOSTIC Command Descriptor Block — Data Format

Table 4-103. SEND DIAGNOSTIC Command Data — Field Descriptions

Field Name	Description
PF	Page Format. Not supported; must be 0.
Selftst	Self Test. This bit is used in conjunction with DevOfl and UnitOfl to specify the type of testing to be done.
DevOfl	Device Offline. This bit is used in conjunction with Selftst and UnitOfl to specify the type of testing to be done.
UnitOfl	Unit Offline. This bit is used in conjunction with Selftst and DevOfl to specify the type of testing to be done.

4.29 SET DEVICE IDENTIFIER Command (A4h)

The SET DEVICE IDENTIFIER command requests that the device identifier information is returned to the REPORT DEVICE IDENTIFIER command to be set to the data passed in the parameter list. The device identifier is persistent through Reset and power cycles.

On successful completion of a SET DEVICE IDENTIFIER command, a unit attention shall be generated for all initiators except the one that issued the service action. When reporting the unit attention condition, the additional sense code shall be set to DEVICE IDENTIFIER CHANGED.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (A4h)							
1	Reserved			Service Action (06h)				
2 - 5	Reserved							
6 - 9	(MSB) Parameter List Length (LSB)							
10	Reserved							
11	Control							

Figure 4-107. SET DEVICE IDENTIFIER Command Descriptor Block — Data Format

The Identifier field shall be a vendor specific value, to be returned in subsequent REPORT DEVICE IDENTIFIER commands.

Table 4-104. SET DEVICE IDENTIFIER Command Descriptor Block — Field Descriptions

Field Name	Description
Service Action	Must be 06h. Any other value will return CHECK CONDITION with the sense key set to ILLEGAL REQUEST.
Parameter List Length	Specifies the length in bytes of the Identifier that shall be transferred from the application client to the device server. The maximum value for this field shall be 64 bytes. A parameter list length of zero indicates that no data shall be transferred, and that subsequent REPORT DEVICE IDENTIFIER commands shall return an Identifier length of zero. If the parameter list length exceeds 64 bytes, then the drive will return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB.

The SET DEVICE IDENTIFIER parameter list contains the identifier to be set by the addressed logical unit.

Bit Byte	7	6	5	4	3	2	1	0
0 - n	Identifier							

Figure 4-108. SET DEVICE IDENTIFIER Parameter List — Data Format

Table 4-105. SET DEVICE IDENTIFIER Parameter List — Field Descriptions

Field Name	Description
Identifier	Data to be returned by all subsequent REPORT DEVICE IDENTIFIER commands, until replaced by another valid SET DEVICE IDENTIFIER command.

4.30 SPACE Command (11h)

The SPACE command provides a variety of positioning functions that are determined by Code and Count fields in the Command Descriptor Block. Both forward (toward End of Medium/End of Partition) and reverse (toward Beginning of Medium/Beginning of Partition) positioning are provided.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (11h)							
1	Logical Unit Number			Reserved		Code		
2 - 4	(MSB) Count (LSB)							
5	Unused		Reserved				Flag	Link

Figure 4-109. SPACE Command Descriptor Block — Data Format

Table 4-106. SPACE Command Data — Field Descriptions

Field Name	Description
Code	The code can be one of the following: **Space Code** / **Space By** 000h — Blocks 001b — Filemarks 010b — Sequential Filemarks 011b — End of Data
Count	When spacing over blocks or marks, the Count field is interpreted as follows: • A positive value N causes forward motion over N blocks or marks. The tape is logically positioned after the Nth block or mark on the EOM or EOP side. • A value of 0 causes no change in logical position. • A negative value -N (two's complement notation) causes reverse movement over N blocks or marks. The tape is logically positioned on the BOM or BOP side of the Nth block or mark. • When spacing to EOD, the Count field is ignored. Forward movement occurs until the drive encounters EOD. The position is such that a subsequent WRITE command would append data after the last object that has been written to tape before EOD.

A SPACE command in the form "SPACE N blocks" will halt with GOOD status after the Nth block, or with CHECK CONDITION status on any occurrence of Filemark, EOD or BOM/P. A command "SPACE N Filemarks" will halt on the Nth Filemark with GOOD status on any occurrence of EOD or BOM/P.

Depending on the size of blocks, read ahead data in the buffer allows some spacing requests to be satisfied without actual tape movement.

4.31 TEST UNIT READY Command (00h)

The TEST UNIT READY command checks the tape drive to ensure that the unit is ready for commands involving tape movement.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	Logical Unit Number			Reserved				
2 - 4	Reserved							
5	Unused		Reserved				Flag	Link

Figure 4-110. TEST UNIT READY Command Descriptor Block — Data Format

4.32 VERIFY Command (13h)

The VERIFY command directs the tape drive to verify one or more blocks beginning with the next block on the tape. Both CRCs and EDCs are validated.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (13h)							
1	Logical Unit Number			Reserved		Immed	BC	Fixed
2 - 4	(MSB) Verification Length (LSB)							
5	Unused		Reserved				Flag	Link

Figure 4-111. VERIFY Command Descriptor Block — Data Format

Table 4-107. VERIFY Command Data — Field Descriptions

Field Name	Description
Immed	Immediate. When set to 1, the VERIFY command completes before any tape medium movement is done (that is, when the processing has been initiated).
BC	Byte Check. Byte checking is not supported by the Super DLTtape drive. This field must be set to 0.
Fixed	This bit specifies whether fixed-length or variable-length blocks are to be verified. When set to 0, Variable-block mode is requested. A single block is verified with the Verification Length specifying the maximum number of bytes the initiator has allocated for verification. When the Fixed bit is set to 1, the Verification Length specifies the number of blocks to be verified. This is valid only if the logical unit is currently operating in Fixed Block mode.
Verification Length	This field specifies the amount of data to verify, in blocks or bytes as indicated by the Fixed bit.

4.33 WRITE Command (0Ah)

The WRITE command transfers one or more blocks from the host to the current logical position. When in Buffered Mode (the default mode of operation), the tape drive reports GOOD status on WRITE commands as soon as this data block has been transferred to the data buffer. Refer to the "MODE SELECT (6) / (10) Command (15h / 55h)" for more information on Buffered Mode.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (0Ah)							
1	Logical Unit Number			Reserved				Fixed
2 - 4	(MSB) Transfer Length (LSB)							
5	Unused		Reserved				Flag	Link

Figure 4-112. WRITE Command Descriptor Block — Data Format

Table 4-108. WRITE Command Data — Field Descriptions

Field Name	Description
Fixed	The fixed bit specifies both the meaning of the Transfer Length field and whether fixed-length or variable-length blocks are to be transferred. When the Fixed bit is 0, Variable-length block mode is selected. A single block is transferred from the initiator and is written to the logical unit beginning at the current logical tape position. Upon successful termination, the tape is logically positioned after this block (on the EOM/P side). The Transfer Length specifies the number of bytes that the drive handshakes out from the initiator as one block. When the Fixed bit is 1, the Transfer Length field specifies the number of blocks to be transferred to the host beginning at the current tape position. This form of WRITE is valid only if the logical unit is currently operating in the Fixed Block mode. When the Block Size field in the Mode Parameter Block Descriptor is non-zero (see "Mode Parameter List" on page 4-68 and "Read / Write Error Recovery Page (01h)" on page 4-74). The current block length is the block length defined in the MODE SELECT command. Upon termination, the tape is logically positioned after these blocks.
Transfer Length	This field contains the length of the data transfer in bytes or blocks depending on whether Fixed or Variable block mode is selected. When the Transfer Length is 0, no data is transferred and the current position on the logical unit is not changed.

Exception Conditions

If End of Tape (EOT) is detected while writing, the tape drive finishes writing any buffered data. The command terminates with CHECK CONDITION status. Within the sense data, the EOM bit is set, the Sense Key field is set to NO SENSE, and the Additional Sense code and Additional Sense Code Qualifier fields are set to EOM/P detected. The drive attempts to complete any subsequent writes, returning a CHECK CONDITION status in each case.

If the tape drive encounters the physical End of Medium (EOM) when attempting WRITE, a CHECK CONDITION status is returned. Within the sense data, the EOM and Valid bits are set, and the Sense Key field is set to VOLUME OVERFLOW. The Information fields contain the residue count and the Additional Sense code and Additional Sense Code Qualifier fields are set to EOM/P Detected. The tape is physically positioned at EOM/P.

4.34 WRITE BUFFER Command (3Bh)

The WRITE BUFFER command is used with READ BUFFER as a diagnostic function for testing the device data buffer, DMA engine, SCSI bus interface hardware, and SCSI bus integrity. It is also used for downloading and updating microcode (firmware).

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Bh)							
1	Logical Unit Number			Reserved	Mode			
2	Buffer ID (00h)							
3 - 5	(MSB) Buffer Offset (LSB)							
6 - 8	(MSB) Transfer Length (LSB)							
9	Unused		Reserved				Flag	Link

Figure 4-113. WRITE BUFFER Command Descriptor Block — Data Format

Table 4-109. WRITE BUFFER Command Descriptor Block — Field Descriptions

Field Name	Description
Mode	The tape drive supports the following values within the field. If any other value is set, the drive terminates the command with CHECK CONDITION status and an ILLEGAL REQUEST sense key set. **Mode** — **Description** 0000b — WRITE combined header and data 0010b — WRITE data 0100b — Download microcode 0101b — Download microcode and save 1010b — Echo Buffer
Buffer ID	The modes described for the Mode field only support a Buffer ID of 0, except Echo Buffer mode, which ignores the mode field. If the Buffer ID field is a value other than 0, the command is rejected. The target detects and rejects commands that would overrun the buffer.
Buffer Offset	**Mode** — **Description** 0000b — Page 4-200 0010b — Page 4-201 0100b — Page 4-201 0101b — Page 4-202 1010b — Page 4-202

4.34.1 Write Combined Header and Data Mode (0000b)

The data to be transferred is preceded by a 4-byte header consisting entirely of reserved bytes. This header is discarded (not stored within the buffer).

The Buffer Offset field must be set to 0 for this mode.

4.34.2 Write Data Mode (0010b)

Similar to Header and Data Mode, except there is no header in the data passed to the target. Any potential buffer overruns are detected and the WRITE BUFFER command is rejected.

4.34.3 Download Microcode Mode (0100b)

This mode is used to use buffer offsets to download the firmware image into the target's buffer in pieces. The firmware image must be downloaded in integral (whole) multiples of 8K bytes. These commands do not cause the new image to become active. A Download and Save Mode WRITE BUFFER command must be issued for the image to become active.

The tape drive must be empty of tape medium before an image can be downloaded. This is a safeguard against accidentally starting a firmware update. If a tape cartridge is loaded when all or part of a firmware image has been downloaded, another WRITE BUFFER command with Download Microcode mode will be rejected.

Any error on a WRITE BUFFER command causes any downloaded image data to be discarded and the download must be restarted from the beginning.

4.34.4 Download Microcode and Save Mode (0101b)

This mode is used to download and save the entire image at once, or to download the image and save it, or to cause a save operation after the image data has been downloaded using the Download Microcode mode (without the Save).

This mode of the WRITE BUFFER command causes the image data to be verified and the Flash EEPROM firmware area to be updated. During the reprogramming of the Flash EEPROM, the Write Protect and Drive Status LEDs on the drive's front panel blink. Also, when it is updating the EEPROM, the tape drive disconnects from the SCSI bus and will not respond until the update is complete.

When the Save operation is successfully completed, the firmware restarts itself, causing the Power On Self Test (POST) to be run, and two UNIT ATTENTION conditions are generated: POWER UP RESET and OPERATING CODE HAS CHANGED.

> **CAUTION:** During the actual reprogramming of the FLASH EEPROM, if any type of power failure occurs, or if the reprogramming fails before completion, the tape drive subsystem becomes unusable and the tape drive must be replaced.

4.34.5 Write Data to Echo Buffer (1010b)

In this mode, the drive transfers data from the application client and stores it in an Echo Buffer. The Buffer ID and Buffer Offset fields are ignored in this mode. Once a WRITE BUFFER command completes successfully, the data is preserved in the Echo Buffer *unless* there is an intervening command to write to the Echo Buffer, or if the drive is reset in any way.

4.35 WRITE FILEMARKS Command (10h)

The WRITE FILEMARKS command directs the tape drive to write the specified number of Filemarks beginning at the current logical position on tape. If the Immediate bit is not set, any data or Filemarks in the WRITE cache buffer are written to tape.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (10h)							
1	Logical Unit Number			Reserved			WSMk (0)	Immed
2 - 4	(MSB) Number of Filemarks (LSB)							
5	Unused		Reserved				Flag	Link

Figure 4-114. WRITE FILEMARKS Command Descriptor Block — Data Format

Table 4-110. WRITE FILEMARKS Command — Field Descriptions

Field Name	Description
WSmk	Write Setmark. Must be 0. This tape drive does not support Setmarks.
Immed	Immediate. When this bit is set to 0, the drive does not return status until all buffered data and Filemarks are written to the medium. If set to 1, the drive returns status as soon as the Command Descriptor Block has been validated. If the Immed bit is set to 1 and the drive is not operating in Buffered mode (see Table 4-40 on page 4-70), the drive will return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense data set to INVALID FIELD IN CDB.
Number of Filemarks	This field contains the number of consecutive Filemarks to be written to tape medium. A value of 0 is not considered to be an error; GOOD status is returned.

The WRITE FILEMARKS command may be used to force the tape drive to write any buffered WRITE data to the tape medium. If the tape drive is in buffered mode, and WRITE FILEMARKS is received, the requested filemarks are

appended to the data and the WRITE buffer contents are flushed to tape medium. A value of 0 in the Number of Filemarks field indicates that no filemarks are to be written to the tape medium, but still flushes any WRITE data to the tape, if the Immed bit is set to 0.

If End of Tape (EOT) is detected while writing filemarks, the tape drive finishes writing any buffered data and terminates with CHECK CONDITION status. Within the Sense data, the End of Medium (EOM) bit is set, the Sense Key field is set to NO SENSE and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P DETECTED. The tape drive attempts to complete any subsequent WRITE FILEMARKS, returning a CHECK CONDITION status in each case. If the tape drive encounters the physical EOM when attempting a WRITE FILEMARKS, it returns CHECK CONDITION status.

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